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APRIL 1953

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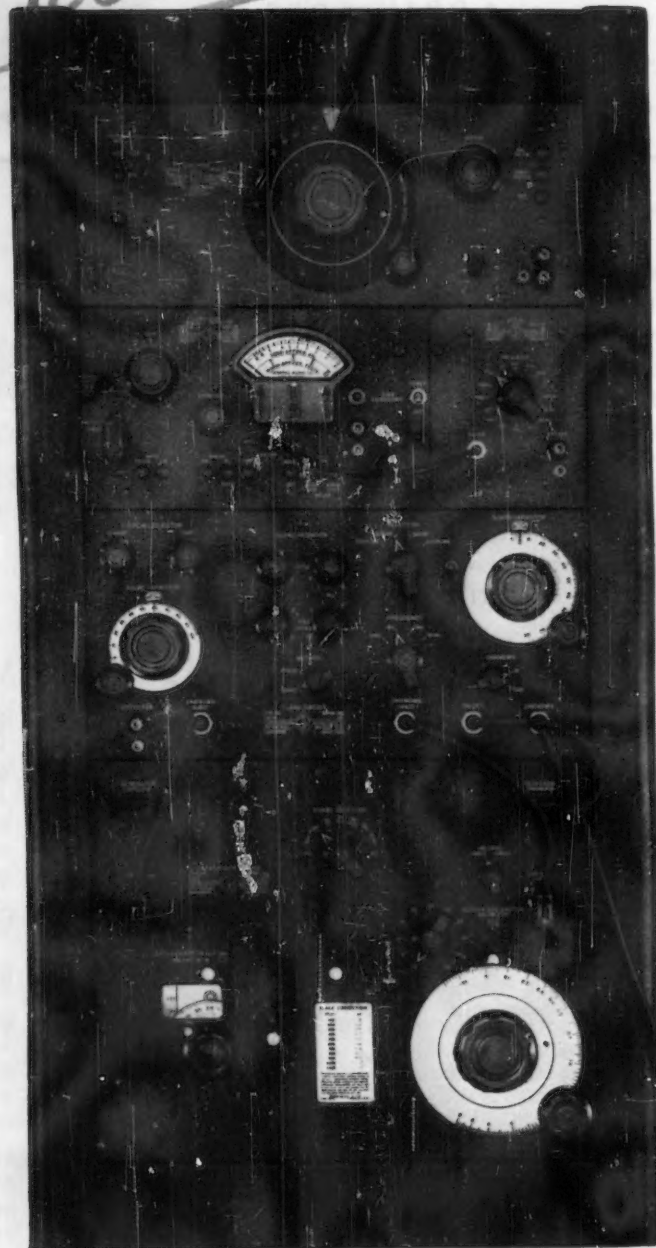
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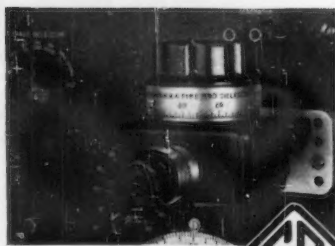
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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 189

APRIL, 1953

Notes on ASTM Committee Week and Spring Meeting

1050 Technical Men in Attendance at Detroit, March 2 to 6
Important Standardization and Research Work on Materials Announced

AT THE 300 meetings of ASTM technical groups during ASTM Committee Week in Detroit, March 2 to 6, much new research work was discussed, and many new specifications and tests for materials and numerous revisions were completed. Total registration was 1050.

A large number of meetings are concentrated during this week so that the committee members can attend the various meetings with considerable saving of time and expense.

Most of the new and revised standards completed at the meeting are subject to letter ballot in the committees before being referred to the Society for action. In general the new specifications will be considered finally at the ASTM Annual Meeting in Atlantic City during the week of June 29, although some may be approved prior to that meeting through the Administrative Committee on Standards.

A list of the major committees which met in Detroit appears in the accompanying box. Most of these had numerous subcommittee and section meetings. Technical committees which convened recently in other cities are also noted.

A-1 on Steel

Departing from its usual practice of meeting during the winter in the East or Midwest, Committee A-1 held a series of meetings in Birmingham, Ala., from February 3 to 5. The meetings were extremely well attended with over 150 members present, and many constructive recommendations were made to the committee by the eleven subcommittees which participated. Local arrangements for the meeting were handled by H. P. Bigler, Vice-President, Birmingham Chamber of Commerce, formerly active in A-1, and J. R. Trimble, Manager, Department of Metallurgy, Inspection and Research, Tennessee

Coal & Iron Division. Many of the members visited the extensive plants of the TC&I Division of the U. S. Steel Corp.

Mechanical Testing.—The manual on mechanical testing of steel is in its final stage, having been approved by the majority of the subcommittees. The latest draft will be submitted to the committee members for letter ballot vote in the hope of recommending it to the Society in June for publication.

Steel Rails and Accessories.—The Subcommittee on Steel Rails and Accessories recommended that Tentative Specification for Open-Hearth Carbon-Steel Rails (A 1) be revised to permit spectrographic analysis and that it be advanced to standard. In Tentative Specifications for Quenched Carbon-Steel Joint Bars (A 49) and for Heat-Treated Carbon and Alloy Steel Track Bolts and Nuts (A 183) the bend test is being revised to permit the use of a pin with a diameter not greater than three times the thickness of the specimen.

Structural.—The Subcommittee on Structural Steel has been cooperating with the General Services Administration and the American Welding Society looking toward the development of a suitable specification for weldable steel. At present comments are being submitted on Interim Federal Specifications QQ-S-00741 and QQ-S-741. The need for another grade of steel for plates over $1\frac{1}{2}$ in. in thickness in Specifications for Ship Steel (A 131) has been noted and recommendations made to cover this situation. The range of ultimate tensile strength for shapes furnished to Tentative Specification A 7 will be changed from "60,000 to 72,000 psi" to "60,000 to 75,000 psi".

Concrete Reinforcement.—A tentative revision to Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement (A 185) was recommended. The tentative revision will include the addition of definite weld

tests and procedures to limit the weld strength in shear for fabric to a minimum of 35,000 psi, based upon the area of the longitudinal wire. In addition a better definition of "maximum average spacing" was recommended for Specification A 305 covering minimum deformation requirements for deformed concrete reinforcement bars.

Forgings.—To facilitate meeting the tensile strength requirements the carbon content of grade F in Specifications for Carbon Steel Forgings for Locomotives and Cars (A 236) is being raised from "0.40 to 0.55" to "0.45 to 0.59" per cent. Acting on a request of the ASME Boiler Code Committee a proposed specification for carbon and alloy steel forgings for pressure vessel shells has been developed and recommended for publication. These forgings are usually produced by cupping and drawing slabs or plates, piercing and drawing billets, or by closing in the open ends of the shells thus produced or the ends of seamless pipe or tubing. Three carbon steel and five alloy steels are covered.

Pipe and Tubing.—In Specifications A 161, A 200, and A 271 covering still tubes for refinery service it is proposed to change the weight tolerances from "3½ per cent over and 5 per cent under" to be "5 per cent over and under." Also an explanation as to how the weight is calculated will be added. In the interests of standardization and elimination of discrepancies the flange test requirements for welded tubing furnished to Specifications A 178, A 226, A 249, and A 250 are recommended for revision. An existing tentative revision to Standard Specification for Seamless Austenitic Chromium-Nickel Steel Still Tubes (A 271) covers the reduction of the number of tension tests required. It is recommended to adopt this as standard and also to similarly revise Standard Specification for Seamless and Welded Ferritic Stainless Steel Tubing (A 268).

Plates for Pressure Vessels.—In order to permit Specification A 300 to cover steel plates suitable for temperatures down to minus 325 F, the 9 per cent nickel steel covered by Specification A 353 will be included. A provision for stress relieving this steel at 1025 to 1085 F will also be added.

Bar Steels.—The Subcommittee on Bar Steels took action to authorize the withdrawal of the emergency alternate provisions for alloy steels covered by Specifications A 286, A 304, A 322, and A 331, at such time as National Production Authority drops the restrictions on nickel and molybdenum.

Sheet Steel.—Two proposed new specifications have been given to Committee A-1 for consideration. One covers cold-rolled carbon-steel deep drawing sheet specially killed for miscellaneous drawn or severely formed parts. The other is concerned with commercial quality cold-rolled sheets. It is expected that these will be published by the Society in 1953.

Bolting.—In Specifications for Machine and Tap Bolts (A 307) the gage length for the tension test specimen will be changed from three threads to six threads. Also in Specification A 307 it is proposed to change "stripping load" to "proof load" and permit nuts over 1½ in. in diameter to be accepted on the basis of a minimum hardness of 104 Brinell where tension test equipment of sufficient capacity is not available. The minimum tempering temperature for quenched and tempered alloy steel bolts and studs in accordance with Specification A 354 will be changed from "800 F" to "850 F." Likewise the gage length for tension test specimens in Specification A 354 will be changed from the nominal diameter of the bolt thread to be six threads. A consumers task group representing the structural field has continued its review of Specification for Quenched and Tempered Steel Bolts and Studs (A 325) and the result has been many editorial clarifications of the mechanical property tests as well as definite requirements for marking.

High Temperature Castings.—To Specification A 217 covering alloy steel castings for pressure-containing parts for high temperature service will be added a 1.25 chromium, 0.50 molybdenum, 0.20 vanadium steel with tensile properties similar to the present grades WC4, WC5, WC6, and WC9.

High Temperature Forgings.—The chromium content of grade F12 covered by Specification for Alloy Steel Forged or Rolled Pipe Flanges, Forged Fittings, etc. (A 182), will be raised from "0.80 to 1.10" to be "0.85 to 1.20" per cent.

RECENT COMMITTEE MEETINGS

- A-3 on Cast Iron
- A-5 on Corrosion of Iron and Steel
- A-7 on Malleable-Iron Castings
- A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys
- B-3 on Corrosion of Non-Ferrous Metals and Alloys
- B-6 on Die-Cast Metals and Alloys
- B-7 on Light Metals and Alloys, Cast and Wrought
- B-8 on Electrodeposited Metallic Coatings
- C-1 on Cement
- C-7 on Lime
- C-8 on Refractories
- C-9 on Concrete and Concrete Aggregates
- C-11 on Gypsum
- C-12 on Mortars for Unit Masonry
- C-15 on Manufactured Masonry Units
- C-16 on Thermal Insulating Materials
- C-17 on Asbestos Cement Products
- D-1 on Paint, Varnish, Lacquer, and Related Products
- D-3 on Gaseous Fuels
- D-4 on Road and Paving Materials
- D-5 on Coal and Coke
- D-8 on Bituminous Waterproofing and Roofing Materials
- D-11 on Rubber and Rubber-Like Materials
- D-16 on Industrial Aromatic Hydrocarbons
- E-1 on Methods of Testing
- E-4 on Metallography
- E-5 on Fire Tests of Materials and Construction
- E-7 on Non-Destructive Testing
- E-9 on Fatigue
- E-10 on Radioactive Isotopes
- E-12 on Appearance

The following committees met recently in locations other than Detroit:

- A-1 on Steel (Birmingham)
- B-4 on Electrical Heating, Resistance, and Related Alloys (New York)
- C-3 on Chemical-Resistant Mortars (New York)
- D-2 on Petroleum Products and Lubricants (Cleveland)
- D-6 on Paper and Paper Products (New York)
- D-19 on Industrial Water (St. Louis)
- E-2 on Emission Spectroscopy (Pittsburgh)
- E-13 on Absorption Spectroscopy (Pittsburgh)
- E-14 on Mass Spectrometry (Pittsburgh)

High Temperature Bolting.—In Specification for Carbon and Alloy Steel Nuts (A 194) the recommendation is made to delete grade 0 nuts, to exempt all nuts too large to be tested in a 60,000-lb machine from the stripping test, and to exempt hot and cold forged

nuts and nuts punched from flat bars from the drift test. Both in Specification A 194 and in Specification for Alloy Steel Bolting (A 193) the chemical requirements for the free machining 18-8 grade will be brought into agreement with the standard commercial grade.

High Temperature Pipe.—Because of objections of the Boiler Code Committee of the ASME to certain provisions of Specification for Electric-Fusion-Welded Pipe (A 155) it has been decided to eliminate class 2 and reword the specification to comply with Sections I and VIII of the ASME Boiler Construction Code. A proposed new specification for seamless ferritic alloy steel forged and bored pipe is under consideration in Subcommittee XXII. This specification will cover ten grades of steel.

A-3 on Cast Iron

The increasing interest in the use of cast iron for applications at very low temperatures approaching those of liquid air resulted in a move to organize an investigation of the problem with a view toward preparing suitable specifications. It was announced that Committee A-3 expects to contribute to the symposium on "Low Temperature Properties of Materials" which is to be held in June in Atlantic City.

The Subcommittee on Nodular Iron discussed proposals to establish specifications at strength levels of 60,000, 90,000, and 120,000 psi. These values are far beyond the range of gray cast irons and the subcommittee is engaged in developing and assembling available information.

Specifications for Automotive Gray Iron Castings (A 159) are being revised to permit higher sulfur contents resulting from the use of the current available materials.

Committee XX dealing with soil pipe such as is used for drainage systems of homes and other buildings has undertaken the modification of existing specifications to accommodate lighter weight (per foot) pipe and standardize dimensions to permit interchangeability.

The application of cast iron to service at elevated temperatures will be studied under the auspices of the Joint Committee (ASTM-ASME) on the Effect of Temperature upon Metals.

A-7 on Malleable Iron-Castings

A report of investigations into the impact properties of malleable iron at both elevated and subzero temperatures

was made at the meeting of Subcommittee I of Committee A-7 on Malleable Iron. Excellent retention of the characteristic room temperature impact properties was revealed. It was suggested that this information should be made available during the Symposium on Metallic Materials at Low Temperatures to be held in conjunction with the 1953 Annual Meeting of the Society. Meanwhile a further study of the impact behavior of malleable iron is planned.

The committee also took action looking toward the adoption as standard of the Tentative Specifications for Pearlitic Malleable Iron Castings (A 220). It was decided to continue in its present status the Tentative Specifications for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service (A 338). More experience is needed in the application of these specifications, which are a replacement for Specifications A 277 discontinued in 1951.

A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys

Committee letter ballot stage has now been reached in Committee A-10 for the proposed Tentative Specifications for Stainless Steel Strand Wire. There has been a long-felt need for a specification for this material.

A number of revisions were approved for letter ballot. It is proposed to add seven additional stainless steel grades to Specifications for Hot-Rolled and Cold-Finished Corrosion-Resisting Steel Bars (A 276). The tensile strength Grade D of Specifications for Corrosion-Resisting Chromium Steel Plate, Sheet and Strip (A 176) and for Corrosion-Resisting Steel Plate, Sheet and Strip for Pressure Vessels (A 240), is to be changed, and Paragraph (c) and the bend test section of A 240 will be revised. A 240 and Specifications for Corrosion-Resisting Plate, Sheet and Strip (A 167) will be more comprehensive with the addition of AISI type 305. A 176 and A 167 are to be further revised to conform to AISI type numbers.

New work in the committee includes the study of the extra low-carbon grades of 304 and 316. The work of the recently formed Subcommittee XII on Specifications for High Temperature Super Strength Alloys, organized under the direction of H. D. Newell, Babcock & Wilcox Co., as chairman *pro tem*, is now under the guidance of Chairman L. L. Wyman of the National Bureau of Standards. Present efforts are directed toward the establishment of three specifications based on the use of the material.

Non-technical Talk Enthusiastically Received at Spring Meeting Dinner

IN ADDITION to the Symposium on Gloss, one of the interesting features of the Detroit Spring Meeting was the cocktail party and dinner arranged by the Detroit District. The some 300 members and committee members at the dinner, with quite a number of ladies in attendance, were privileged to hear a really outstanding address by Dr. Kenneth McFarland, Educational Consultant to General Motors. His address was both entertaining and edifying, with an excellent balance of humor and serious comments. At the close there was prolonged applause, and afterwards many members congratulated the Detroit District officers on the selection of Dr. McFarland as the speaker.

Among the points which he stressed in parts of his address was the glory of the common way, the importance of the common man in our life and economy. He deplored the indifference toward others which so many of us show. He stressed the importance and significance of enthusiasm in our activities, and emphasized the importance of going the second mile.

Following the introduction of those at the head table including local and national officers of the Society, ASTM President H. L. Maxwell extended greetings, complimented the Detroit



Kenneth McFarland

District on their part in the Spring Meeting, and asked for the cooperation of all in the Society in attempting to cope with the growing scarcity of well-trained technical men.

Most of the arrangements for the meeting were directed by the District Vice-Chairman A. J. Herzig, Climax Molybdenum Co., and the District Secretary C. O. Durbin, Chrysler Corp. Presiding at the dinner and cooperating in last-minute arrangements was District Chairman D. M. McCutcheon who drove to the meeting from Florida where he has been recuperating from a prolonged illness.

B-3 on Corrosion of Non-Ferrous Metals and Alloys

Continued progress was reported in the solution of problems associated with the corrosion of non-ferrous metals and alloys.

The controversial salt spray test is still being scrutinized with the thought of making improvements to increase its reproducibility and broaden its applicability. One of the current questions revolves about the use of a 20 per cent salt solution *versus* 3 or 5 per cent solutions.

Subcommittee VI on Atmospheric Exposure is currently seeking means of having analyzed statistically the data resulting from the 20-year tests of some 20 different non-ferrous metals and alloys. A number of specimens from the original test will remain in storage at the National Bureau of Standards and it was agreed by the group that samples of the materials commercially used outdoors today be exposed at the new ASTM test sites with the thought of correlating these new tests with the original series. The specimens this

time will be 4 by 6 in. as compared with the old 9 by 12-in. size.

Subcommittee VIII on Galvanic and Electrolytic Corrosion has recalled the first of three series of Part I of a three-part program of galvanic corrosion testing. Part I consists of disk type couples. Part II is virtually complete as far as actual exposure. However the testing and weighing of these wire-wound bolt couples still remain to be done. The materials for the plate-type specimens, Part III, have to be obtained and plans are being made for procuring these materials.

B-6 on Die-Cast Metals and Alloys

Committee B-6 made progress in many phases of its work on die castings, but will have only one item to come before the Society in June. Currently out to the committee for consideration by letter ballot is a change in the copper limit in Alloy XXIII from 0.10 to 0.15 per cent as shown in the Standard Specifications for Zinc Base Alloy Die Castings (B 86).

(Continued on page 10)

Symposium on Gloss at ASTM Spring Meeting in Detroit

THE 1953 Spring Meeting of the Society, held in Detroit, March 4, featured a Symposium on Gloss sponsored by ASTM Committee E-12 on Appearance. The morning session was confined to a beautifully illustrated lecture by Ralph M. Evans, Control Department Head, Eastman Kodak Co., on "Surfaces as Seen and Photographed." The afternoon session consisted of two papers; one by Harry K. Hammond, III, Physicist, National Bureau of Standards and Daniel Smith, Physicist, Research Laboratories, Interchemical Corp., on "The Physics of Surface Reflection"; the other by Richard S. Hunter, Director, Hunter Associates Laboratory, on "Gloss and Its Measurement." These papers were then followed by an open panel discussion under the chairmanship of Deane B. Judd, Head of Colorimetry Unit, National Bureau of Standards, the panel consisting of the authors of the several papers.

Abstracts of the three papers presented at this Symposium follow.

• • •

Surfaces as Seen and Photographed

By Ralph M. Evans

IN ORDER to understand the problem of describing a surface by photographic means, it is first necessary to understand the visual process involved, both in looking at surfaces and in looking at photographs. The talk, which was illustrated by 100 color slides, accordingly was divided into five sections, as follows: (1) It was pointed out and demonstrated that there is no simple relation between the physical properties of surfaces and their appearances. A high gloss surface does not *always* appear glossy, etc. (2) The visual processes were next discussed by which it is possible to see that a surface does have a particular type of physical structure. The basis for such a decision lies in our knowledge through experience as to how object properties appear in certain *situations*—lighting, adjacent objects, etc. (3) The process of interpreting a photograph was next discussed. It was pointed out that in this operation the picture was consciously considered to discover (a) the situation, (b) the clues about the objects. (4) It follows from this that the photographer must see to it that adequate information is contained in the photograph so that correct interpretations are made. Ambiguous situations must be avoided. (5) In addition to

these considerations it was pointed out that single lens single picture black-and-white photography cannot reproduce all the properties that a surface may possess. For some surfaces (deep glazes, for example) stereoscopic pictures are needed. For some others (sparkle, for example) motion pictures are required. For many subjects (colored papers, for example) color is a definite necessity.

In summary—although there is no unique appearance which a given surface shows under all conditions, an ordinary viewing situation shows enough clues as to the true nature so that it is possible to figure it out. Photographs are seen in the same manner and it is required that the photographer supply adequate clues for interpretation *but* the kind of photography used must be adequate to the task as well as the photographer.

On the other hand it was pointed out that if you want a photograph of a particular property of an object, you can almost always get it. Take the object to a competent photographer. Show him the *appearance* that you and others *can interpret* as meaning that property. He *can* then produce a photograph of it by one means or another. Any visible optical phenomenon external to the eye *can* be photographed, with very few exceptions.

• • •

The Physics of Surface Reflection

By Harry K. Hammond, III, and Daniel Smith

THE basic equations and laws of physics governing reflection at the surface of a polished specimen were reviewed. First discussing dielectric materials, it was shown that the intensity of a specularly reflected beam of unpolarized incident light could be computed from a combination of the equations of Fresnel and Snell when the angle of incidence of the light and the refractive index of the material are known. The refractive index of the material may be obtained by measurement with an Abbé refractometer. This is the method used for calibrating primary gloss standards from material such as polished black glass.

Factors influencing reflection from metallic materials were compared with those for dielectric materials. Attention was drawn to the fact that metals have much higher reflectance and absorbance than dielectrics. It was

pointed out that reflection of light by dielectric materials is presumed to be controlled by the bound electrons in the molecules of the material, but that in metals the bound electrons are primarily responsible for the reflection of short-wave radiation while the free electrons are responsible for the reflection of long-wave radiation. It is the free electrons that impart to all metals their characteristically high reflectance to long-wave radiation.

It was shown that the equation for computing the fraction of a perpendicularly incident beam reflected from a metal is quite similar to that obtained from the combined Fresnel-Snell equation for a dielectric except that it includes the "extinction coefficient" of the metal. If metals contained no free electrons, this extinction coefficient would be zero, and then the equation for metals would be identical to that for dielectrics.

The physical optical laws which describe the reflectance of light at a dielectric or metallic boundary are usually discussed for rays incident upon plane boundaries. There is no limitation, however, on their application to rough surfaces which may be considered to be constructed from randomly oriented specularly reflecting facets. It is then primarily a matter of obtaining the correct weighted-average-reflectance for each angle of reflectance from a rough surface to determine the characteristics which may be responsible for any shiny appearance.

The light incident upon a specimen may be redistributed by scattering within the medium as well as by reflection at the boundary. This redistribution produced by scattering also influences the gloss of a specimen very markedly. The pronounced difference in gloss between white and black cararra glass is due to the difference in the scattered component.

The behavior of metals and dielectrics differs in (1) the manner in which they polarize light upon reflection, (2) the magnitude of the reflection at the interfaces, and (3) the high extinction coefficient characteristic of metals which results in high absorption.

These differences characterize the physical aspects of the reflected energy, but to determine their pertinence it is essential to consider the ability of the human eye to perceive them.

Under normal conditions of view the eye is completely insensitive to the polarization characteristics of a beam of energy, and therefore this property need not be considered further for gloss evaluation.

Metals reflect considerably more light at their interfaces than do dielec-

tries, and the eye responds to these differences. It is a simple matter to make instruments which respond to these differences, but the problem of making them respond in exactly the same way as does the human eye has not been completely or satisfactorily solved.

The high absorption characteristic of metals is not confined to them, however, for several dielectric materials such as malachite green, methyl violet, selenium, etc., exhibit "metallic" luster. For these materials the high extinction coefficient is associated with strong absorption bands, and is therefore usually highly spectrally selective. But in any case, the higher reflectance which results from the high extinction coefficient can be measured as well as observed.

A single basic method for gloss measurement for all materials therefore, is within the realm of possibility. This is based on the foregoing considerations which indicate that the pertinent differences between materials are those of degree and not kind.

An experimental device for introducing scatter and effectively lowering the extinction coefficient of metals, produces samples which have lost their characteristic "metallic" luster. This was accomplished by vacuum evaporating several different metals onto surfaces of freshly smoked MgO.

Once the necessary fundamental experimental work has been done, the logical and probable result will be a single multidimensional method for the measurement and specification of gloss. The method will parallel, in many respects, that developed for color measurement and specification.

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Gloss and Its Measurement

By Richard S. Hunter

Any gloss scale should be psychophysical; that is, it should be a special physical scale yielding numbers corresponding to visual estimates of gloss. Discussed in some detail were each of four reasons why the gloss-measurement requirements of industry are leading to a multiplicity rather than a unification of gloss scales. These are: (1) complexity of the physical situations responsible for gloss, (2) the variety of visual clues used in the recognition of gloss, (3) the lack of additivity (as in color) or other means of synthetically matching gloss stimuli, and (4) the variability with class of specimens of the geometric conditions best suited for their gloss measurement.

The conclusion was that the science of glossimetry may be expected to de-

velop a series of testing procedures, each applicable to specific types of object surfaces.

This paper by Mr. Hunter has been published in *ASTM BULLETIN*, No. 186, December, 1952. The other two talks are not to be published.

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Panel Discussion

Deane B. Judd, Chairman

TO ILLUSTRATE the trend toward development of new instruments to measure aspects of gloss other than specular gloss, a new instrument was described that has been developed by W. E. K. Middleton of the National Research Council of Canada. This instrument gives meter readings that correlate with visual estimates of distinctness-of-image gloss. It operates by scanning photoelectrically the image of a slit reflected from the specimen. The measured parameter is the maximum rate of change of the photocurrent, which is proportional to the maximum rate of change of directional reflectance in the region adjacent to the axis of the mirror reflected beam.

The question was raised as to the approved numerical limits for the various word descriptions for different degrees of specular gloss. The answer is that Subcommittee X on Optical Properties of ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products has just reviewed this question and has voted to delete this section

in the method of test for specular gloss. One member of this Subcommittee viewed thousands of eggs to gain an idea of what might have been intended by the description "eggshell." He reported finding a very wide variation ranging from what is commonly called "flat" to what is generally described as "medium gloss."

Also questioned was the logic of the trend of specifying narrower gloss tolerances in specifications of 60-deg specular gloss in view of the fact that both Evans and Hunter had emphasized that matching the gloss of two specimens under one set of illuminating and viewing conditions would not insure that they would appear equally glossy under some other set of illuminating and viewing conditions. The answer given was that the numerical limits in a gloss specification should be no narrower than can be justified by the end use of the product. The increased precision of gloss measurement in recent years is probably responsible for the trend to reduce unnecessarily the gloss tolerances in specifications.

A question was asked about the relationship between sheen and surface smoothness. The answer was that Lord Rayleigh had considered this question in a paper published in 1901 where he stated: "The fineness necessary in order that a surface may...appear polished depends on the wave length of the light and upon the angle of incidence." No one knew of any published quantitative expression relating surface roughness and the angle at which sheen or a mirror image is first seen. It was



A-5 Advisory Committee. Standing, left to right: B. J. Barmack, O. B. Ellis, J. G. Thompson, Vice Chairman, F. M. Reinhart, H. F. Hormann. Seated: C. P. Larrabee, Secretary, A. P. Jahn, Chairman, and E. F. Lundeen, Second Vice Chairman.

stated that it is possible to approach the problem from the standpoint of diffraction theory and show that if the facet spacing and departure from the gross plane of the specimen is such that the phase difference between rays reflected from different facets is less than the wavelength of the light then the original wave fronts will be reformed and mirror images will result. In this approach one deduces that the red or long-wave radiation will be imaged before the blue or short-wave radiation and this explains why the image of a reflected source always appears reddish when sheen is first observed. This effect can be demonstrated very nicely with finely ground white or black Vitrolite glass. Another approach to the problem is to consider that a rough surface is composed of a series of hills and valleys. As the angle of incidence approaches grazing, the valleys are masked by the hills and the apparent spacing of the hills is reduced until ultimately if the hills are all the same height the tops of the hills appear to form a continuous plane. In either approach it should be kept in mind that the specularly reflected fraction of each ray increases rapidly as the angle of incidence becomes large; this accounts for the high intensity of images reflected at grazing incidence.

Dr. Judd summarized briefly the views presented by the authors as follows: Hunter attempted to show that more than one kind of gloss measurement is needed in order to obtain correlation with the different appearance criteria for gloss. Evans showed essentially the same sort of thing with photographs of the same surface under different illuminations. Smith suggested that we begin anew by re-examining the basic concepts on which our ideas of the instrumental requirements for glossiness correlation are based. It seems to be his view that the result of such a study would be the development of a single multidimensional method for measurement of gloss. It should be pointed out that this view of the solution of the problem is not essentially different from the views of Evans and Hunter. It is therefore evident that we shall be obliged to use multiple gloss scales. This procedure will be satisfactory if we examine carefully each individual gloss measurement requirement and choose an appropriate scale of measurement in each case.

Hotel Reservations

Hotel reservation forms for 1953 Annual Meeting will be mailed about April 15. If yours fails to reach you by April 30, advise ASTM headquarters.

Committee Week (continued from p. 7)

Subcommittee I on Aluminum-Base Die-Casting Alloys expects within the next year to have ready as an appendix to B 85, Tentative Specifications for Aluminum Base Alloy Die Castings, a table which may be used as a guide in the selection of alloys for particular applications based on the physical properties of the alloys.

Subcommittee V on Exposure and Corrosion Tests, which has had in reserve a supply of the 3 per cent copper-8 per cent silicon aluminum alloy test specimens, is planning to expose these materials for 1 and 3-yr periods at the 80-ft location in Kure Beach, for 5 and 10-yr periods at the 800-ft location at Kure Beach, and for 1, 3, 6, and 12-yr periods in New York and Columbus. The results of the earlier tests on this material will be included in the committee's annual report for this year in bar chart form summarizing all of the data up to the present time. In addition actual figures will be given for the data obtained since 1948.

A paper by Bruno Sachs concerning "die casting processes" has been discussed in Subcommittee IX on Die Casting Processes and will be recommended to the Society for publication.

B-7 on Light Metals and Alloys, Cast and Wrought

Committee B-7 reported progress on numerous revisions of standards including specifications B 26 and B 108 (aluminum sand castings and permanent mold castings, respectively) where special sections relating to pressure vessel applications will be added. The committee is revising the pipe and tube specifications to include schedule 58 and 10S pipe. Alloy GS11A as it appears in the aluminum specifications will have the chromium limit changed from the present 0.15-0.35 to 0.04-0.25 per cent. In the specification for aluminum sheet and plate (B 209) as well as the tube specifications (B 210 and B 234) the minimum tensile strength requirements for Alloy MIA-H14 will be changed from 19,500 to 20,000 psi.

In addition to the above changes in the aluminum standards, the following changes are being recommended in those for magnesium alloys. Four new alloys will be added to Specifications B 80 (sand castings) while Alloy AZ91C-F will be deleted. Alloy ZK60A will be added to both Specifications B 107 (bars, rods, and shapes) and B 217 (extruded tubes) while Alloy AZ80A will be deleted from Specifications B 217.

Subcommittee VI has broadened its scope to include the study of anodic coatings on magnesium as well as on aluminum.

The Codification Subcommittee voted to use Y for antimony in the alloy codification system and a proposed tentative temper designation system is now undergoing simultaneous balloting by the subcommittee and Committee B-7.

Additional new work includes the preparation of a specification for standard structural aluminum shapes. Consideration is also being given to the preparation of a specification for aluminum fasteners.

B-8 on Electrodeposited Metallic Coatings

Subcommittee II on Performance Tests will make available as an appendix to the B-8 report, data on the copper-nickel-chromium and lead deposits over steel. These tests have been on exposure for some 8½ yr, as of the 1932 inspection, and sufficient data have now been accumulated so that it may be possible to draw some definite conclusions. A method for rating panels has been developed by this subcommittee and is currently out to letter ballot of the main committee.

The Subcommittee on Electroplating Practice is submitting to the Society in June a recommended practice for preparation of and plating on copper alloys. In view of the lack of interest, the section on plating of plastics has been dissolved but the two remaining sections, one on plating on lead and one on malleable and cast iron are making steady progress and recommended practices for these two materials should be available within the next year. It was voted, subject to letter ballot, to advance other recommended plating practices to standard. These include recommended practices for B242 (high carbon steel), B252 (zinc), B253 (aluminum), and B254 (stainless steel).

New work of the committee includes the establishment of a section to develop a recommended practice for alkaline cleaning.

An entirely new field of work to be undertaken by the committee will cover the field of tin plating. This investigation will include performance tests of tin coatings on steel and copper as well as the behavior of tin-zinc, tin-lead, tin-cadmium, tin-copper, and tin-nickel coatings. One of the big unanswered problems is that of methods of testing the solderability of tin coatings.

A.E.S. Research Project No. 15 which is endeavoring to create a more

realistic and reproducible test than the current salt spray test is of interest to Committee B-8 and the Society as a whole. Their program envisages a broad test program of nickel and copper-nickel-chromium finishes on steel and die-cast base materials. These panels will be exposed on the front license plate holders of a fleet of taxis in the Detroit area. Accelerated tests will include (a) salt spray and low temperatures with and without the addition of corrosive gases such as SO_2 , (b) the modification of standard salt spray and acetic acid-salt spray tests including periodic infrared drying, (c) continuous immersion in materials scraped from the streets, (d) alternate chilling and spraying with corrosive solutions, (e) investigation of the effect of temperature on galvanic action, (f) positional effect in the paint spray cabinet, (g) use of wetting agents, (h) use of oxidizing agents, and (i) water line effect in immersion tests.

C-1 on Cement

The development of a specification for slag cement was authorized at the meeting of Committee C-1. The Subcommittee on Properties of Slag Cement, after investigation and study, recognized the desirability and need for such a specification. In addition to this new development of ASTM specifications in the cement field, considerable attention was given to the existing specifications covering portland, blended, and masonry cements.

After several years as a tentative, the Tentative Specification for Air-Entraining Portland Cement (C 175) was recommended for advancement to standard. Several changes were recommended in the Standard Specifications for Portland Cement (C 150), including a change in the maximum air content from 15 to 12 per cent, a replacement of the present SO_3 requirement by a leach test and the advancement to standard of the tentative revision pertaining to fineness requirements. The Sponsoring Committee on Masonry Cement reaffirmed its previous action, recommending an autoclave test requirement in specifications C 91, with a maximum limit of 1 per cent expansion at 7 days. The intention to write a specification for pozzolanic cements was reaffirmed by the Sponsoring Committee on Blended Cement, with a questionnaire to be circulated to cover conflicting points.

The use of mechanical mixing apparatus was discussed by several of the working committees, indicating a general trend toward the adoption of mechanical mixing in place of hand mixing where required in the various test methods. The Coordinating Commit-



B-6 Advisory Committee. Standing, left to right: J. W. Meier, E. V. Blackmun, A. E. Weiss, D. Kleppinger. Seated, G. L. Werley, Secretary, and W. Babington, Chairman.

tee on Tests proposed a tentative method for mechanical mixing of hydraulic-cement mortars of plastic consistency, which was accepted for committee letter ballot. Two proposed test methods on strength, namely, flexural and compressive strength, as published for information in the December issue of the ASTM BULLETIN, will be reviewed through a cooperative series of tests to study the effect of mechanical mixing as compared with hand mixing. Eight laboratories will participate, using 24 cements, based on Types I, II, and V. The use of the mechanical mixer is also under way in a cooperative series, not yet completed, on a proposed bleeding test. The round-robin test series to establish the reproducibility of the sulfate resistance test has been completed.

A revision is contemplated in the method for determining and analyzing Darex in C 114 involving a simplification of apparatus and stricter precautions against nitrogen contamination. Investigation is continuing on the suitability of various types of flame photometers for use in testing cement.

C-3 on Chemical-Resistant Mortars

Three proposed tentative methods of tests for resin cement mortars were approved, subject to letter ballot, at its meeting at the Chemists' Club, New York City, on March 11. Two of the proposed methods are intended for determining the tensile strength and the compressive strength of resin mortars. It is recognized that these mortars are not usually under tension when in service, but it is felt that tension data would be useful for purposes of deter-

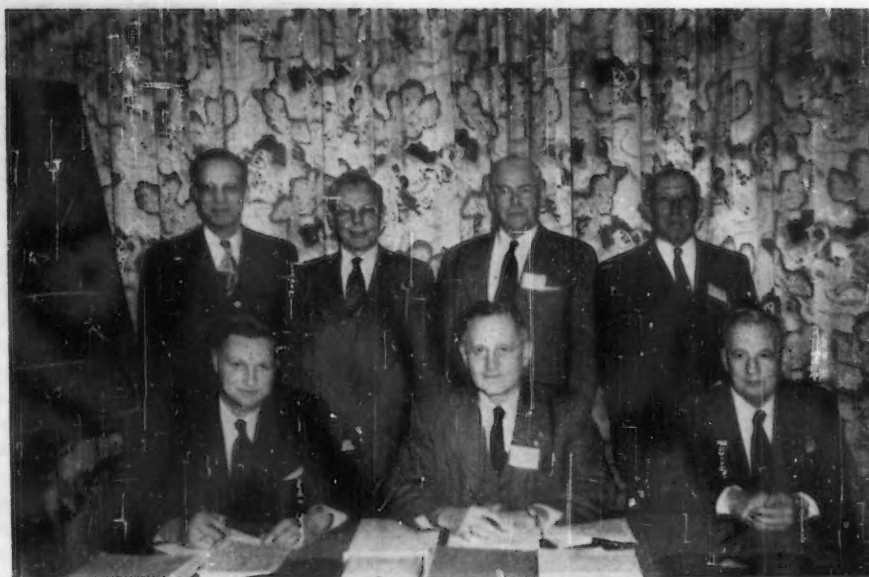
mining the rate of cure and other properties of the mortar. The third proposed method contains procedures for measuring working and setting times of chemical-resistant resin cement mortars with the setting time procedure including both initial and final time of set determinations.

The determination of bond strength has been under study and after a review of several different methods, the best results to date have been secured by using a crossed-brick method. A tentative procedure was distributed for comments, based on tests completed using several types of cements. It was recommended that the data be compiled in the form of an article for the ASTM BULLETIN and that a draft of the complete test method, with supporting data, be presented at the next meeting of the committee, which will be during the 1953 ASTM Annual Meeting in Atlantic City in June.

The latest draft of a proposed method of measuring chemical resistance of resin mortars, with data on a test series using carbon-filled cement test disks, was distributed. After discussion, it was the decision that further cooperative tests be made in the immediate future, using more rigorous test conditions, in order that a full report may be made at the next meeting.

Methods for determining water absorption and volume shrinkage of resin mortars are in progress. A reorganization of the Subcommittee on Silicate Mortars is being effected.

Robert Pierce, Pennsylvania Salt Manufacturing Co., presented first-hand information and illustrations of the chemical-resistant mortar industry in



C-1 Advisory Subcommittee. *Standing, left to right:* E. J. Wechter, P. D. Meisenholder, C. H. Scholer, W. C. Hanna. *Seated:* W. S. Weaver, *Secretary*, R. R. Litehiser, *Chairman*, and J. R. Dwyer.

Europe, especially in Germany, which in his consideration is much further advanced and specialized in this field. Appearance, loss of compressive strength, and loss in weight, in that order, constitute the principal German criteria of the chemical resistance of all chemical-resistant brick.

C-7 on Lime

The thought was expressed at the meeting of Committee C-7 that closer coordination was felt desirable between Committee C-7 and Committee C-12 on Masonry Mortar in proving the new Tentative Specifications for Mortar for Unit Masonry (C 270) in respect to the reference and classification of lime mortars. A joint meeting of the Structural Lime Subcommittee of Committee C-7 and the Mortar Specifications Subcommittee of Committee C-12 is being planned during the 1953 Annual Meeting in Atlantic City to discuss this matter.

A new proposed method for determining the settling rate of lime was accepted for committee letter ballot. Six laboratories will participate in a round-robin testing program to evaluate the different available CaO methods. Another series of round-robin tests, with eight laboratories participating, will compare two autoclave methods, one using a gypsum admixture and the other a portland cement admixture. A reactivity method will be reviewed by a subcommittee.

A new subcommittee was authorized to prepare specifications on lime for soil stabilization.

C-8 on Refractories

No new methods or specifications were presented to Committee C-8 for acceptance. Various factors involved in the load test, both hot and cold type, are being studied with a definite assignment given to Subcommittee III (C) to report on a preferred type of furnace. The Standard Classification of Fireclay Refractories (C 27) will be revised to include a proposed classification for single and double-screened ground refractory material. Progress was reported in the development of proposed methods for various types of basic granular refractories. To assist in this activity, a list of suppliers of this type of refractory material will be compiled, as well as a list of materials other than dolomite in this group. The proposed methods include specific gravity and hydration determinations.

The use of flame photometer methods is being investigated. It was reported that as yet, radioactive tracer techniques have not been found adaptable for use with refractory materials.

C-9 on Concrete and Concrete Aggregates

Proposed specifications for fly ash and for lightweight aggregates in concrete were focal points of interest during the meetings of Committee C-9. The development of these standards has been under way for a considerable time and represent many hours of discussion and study on the part of the respective subcommittees. The Subcommittee on Admixtures recommended the accept-

ance for committee letter ballot of a proposed test method for fly ash as an admixture to portland cement concrete. A proposed specification is being referred back to the subcommittee for further study.

The Subcommittee on Lightweight Aggregates, reported that considerable progress was made toward the development of a complete revision of the existing Specifications for Lightweight Aggregate (C 130). The subcommittee reviewed drafts for three separate specifications, covering lightweight aggregate for insulating concrete, structural concrete, and concrete masonry units. It is expected that definite recommendations for the acceptance of these proposed specifications will be made to Committee C-9 at its next meeting during the 1953 ASTM Annual Meeting.

A new Tentative Specification for Liquid Membrane-Forming Compounds for Curing Concrete was accepted for letter ballot of the committee. An additional grading was recommended for immediate adoption for inclusion in those now listed in the Standard Method of Test for Abrasion of Graded Coarse Aggregate by Use of the Deval Machine (D 289). This grading is similar to one recently adopted by the American Association of State Highway Officials.

Proposed methods, authorized for publication for information only, include a pulse velocity method of dynamic testing of concrete and a method of test for thermal coefficient of aggregates.

Much progress was reported in the various subcommittees in the development of data for standardization purposes. This activity includes the examination of cement paste in concrete for air and water voids; the effect of mineral aggregates with respect to bonding; pore spaces in aggregate; a test for volume change of concrete products; the use of SR-4 strain gages for measuring volume change of coarse aggregate; limitations on alkali activity in the present specification for concrete aggregates (C 33); and a cooperative series for evaluating proposed abrasion test methods. A variety of methods, 17 in all, are being reviewed for the purpose of developing a standard method of testing a time of set of concrete. This activity will be coordinated with Committee C-41 on Cement.

An innovation in the meeting program of the committee was introduced at this meeting in the form of a presentation of several short papers. Four such papers were presented at the close of the business meeting and were very well received. The papers were essentially in the nature of reports from certain subcommittees, and the subjects and authors are noted as follows:

Definition and Methods of Testing Setting Time of Concrete by E. W. Scripture, Jr.
Methods of Testing Reactivity of Concrete Aggregate by R. C. Mielenz
Tests of Truck Mixers by Stanton Walker
Investigation of the Sulfate Soundness Test of Concrete Aggregate by D. O. Woolf

C-12 on Mortars for Unit Masonry

The use of a ceramic wick method to determine the relative efflorescence tendencies of mortars shows promise as a possible standard test method, it was reported at the meeting of Committee C-12. A proposed test procedure will be circulated to the entire committee with accompanying data. In considering the specifications for mortar, suggested changes submitted from Committee C-7 on Lime will be studied. Also, attention will be given to a request for a survey of the lime industry to establish the availability of Type S lime throughout the country. Differences between ASTM Specifications for sand used in plaster (C 35) and aggregate for masonry mortar (C 144) were discussed in the light of results of a survey showing that most sands do not conform to Specification C 144. A study will be made of these differences.

A subcommittee is engaged in preparing a preliminary draft of a specification for pointing mortars. Also, the effect of mortar expansion on flat slab construction is being studied, using 8-ft high piers and cements varying in autoclave expansion from 0.5 to 8 per cent.

C-16 on Thermal Insulating Materials

A new subcommittee on protective coatings has been authorized to implement the action of the committee in expanding its scope to include protective coating materials associated with thermal insulating materials for use in preserving their thermal insulating efficiency. Another new project of the committee, namely, research on the effect of moisture on thermal insulating properties, is reported ready to get under way at The Pennsylvania State College. Funds for supporting this research have been solicited from industry and sufficient response has resulted in the decision to go ahead with the actual work.

A racking load test method for insulating board has been prepared and was approved for committee letter ballot. This method has been informally coordinated with Committee E-6 on Methods of Testing Building Constructions. A proposed sampling method, which originated in the Subcommittee on Block and Pipe Insulation, has been suggested for consideration as a general sampling method for other types of in-

insulating materials as well. The proposed method has been turned over to the Subcommittee on Dimensional Standards to review in light of the expanded scope of the method.

A small-scale flame resistance test method continues to hold priority in three subcommittees, namely, Structural Insulating Board, Blanket Insulation, and Loose Fill Insulation. Round-robin tests are under way to establish data, using a modified form of the test procedure found in the Federal Specification SS-A-118a. The proposed Recommended Practice for Clearances of Pipe Insulation has received final review by the subcommittee.

The Subcommittee on Insulating Cement has task groups studying such characteristics as plasticity, wet adhesion, dry adhesion, and compressive hardness. A proposed tentative method on dry adhesion of cement has been completed. Drafts of proposed methods for measuring specific heat and linear shrinkage of high temperature insulation were reviewed, and in light of comments received, further revisions will be made.

The thermal conductivity of pipe insulation can now be determined by a proposed test method, which is ready for committee letter ballot. A proposed method for measuring water vapor transmission in built-up structures is also being considered.

D-1 on Paint, Varnish, Lacquer, and Related Products

The spring meeting of Committee D-1 was highlighted by an illustrated talk on "The Production Man's View of the

Technical Man's Responsibility," by N. P. Beckwith, Vice-President and Technical Director of Rinsed-Mason Co. Mr. Beckwith discussed the various ways in which technical personnel are in contact with production personnel, and considered the qualities which are most desirable to promote cooperation, understanding, and productive work between the two groups. M. R. Euverard, Chairman of the Papers Subcommittee, who arranged the talk, announced that at the next meeting of Committee D-1 in June there would be a supplementary talk by another author presenting management's view of the technical man's responsibility.

Over a three-day period, there were 70 meetings of D-1 subcommittees and working groups in addition to the main committee meeting.

The programs of work of the technical subcommittees have resulted in recommendations for the adoption of a number of new tentative methods of test and specifications which will be voted on by Committee D-1 in its annual June report. Among these are new proposed tentative specifications for high-gravity glycerin and also new methods of sampling and testing high-gravity glycerin. Revisions of the Tentative Methods of Chemical Analysis of White Pigments (D 34) were submitted.

Also ready for vote of Committee D-1 are a tentative method of test for non-volatile content of resin solutions, and tentative revisions of the methods of test for drying time, gloss, nonvolatile matter and consistency of nitrocellulose clear lacquers and lacquer enamels (D 333). Other new methods of test



C-7 Advisory Subcommittee. Standing, left to right: A. E. Pavlish, N. C. Rockwood, B. L. Corson, P. L. Rogers. Seated: R. S. Boynton, Secretary, and J. A. Murray, Chairman.

recommended for publication as tentative are for color difference measurements with the Hunter Multipurpose Reflectometer, and also a consolidated gloss method which is intended to replace the present Standard Method of Test for 60-Deg Specular Gloss (D 523).

Final work is being done on a number of other proposed new test methods which include fineness of grind of printing inks, a method for determining the settling of traffic paints during storage, a method of test for no-dirt-retention-time of traffic paints, and two different methods for analysis of phthalic anhydride which are applicable in the presence of other interfering dibasic acids.

Progress was reported in the preparation of new proposed tentative methods covering photographic standards for classifying ferrous surfaces for painting, abrasion resistance test of varnishes, method of test for hiding power, and a procedure for sampling drying oils and related materials. A method for determining total unsaturation by hydrogenation, specifications for safflower oil, the drop-test and the contact angle test for cleanliness of steel panels, new photographic standards of blistering, and the application of the foil method for determination of nonvolatile content of heat-sensitive resins are being studied. Work on oil absorption, consistency of pastes, adhesion and hardness, water vapor permeability, flow properties and fire retardency of paints, has also progressed.

The committee also received reports of progress on the preparation of revised specifications for copper phthalocyanine to include flocculation and crystallization types of pigments, methods of test for drying time and specific gravity of printing inks, the revision of the present methods of sampling and analysis of shellac (D 200), determination of cold alcohol insoluble matter, polymerized bodies and color of lac resins, and revision of the method for analysis of dry mercuric oxide.

Some minor changes were recommended in the Proposed Method of Test for Flash Point of Volatile Solvents by the Tag Open-Cup Apparatus which will be again published as information. This proposed method is based on the Manufacturing Chemists' Assn. Draft for Flash Point Determination of Liquids for Classification Under ICC Regulations by Tagliabue Open Cup. A round-robin interlaboratory test program is under way on the development of approved equipment for determining the open cup flash point of viscose materials.

A number of new investigations have been started which include a study of

acid numbers of varnishes, the use of the Tag open-cup method for flash point with nonhydrocarbon solvents which flash in the range of 20 to 80 F, development of a method for measuring the gloss of clear finishes over wood, preparation of specifications for fatty acids, and revision of the Standard Specifications for Oiticica Oil (D 601), development of a moisture check resistance test for wood lacquers, the measurement of dry film thickness of coatings applied to nonmagnetic bases, and specific gravity of paint and paint materials.

D-4 on Road and Paving Materials

Some interesting studies are being made in measuring the effect of water on bituminous mixtures and bituminous coated aggregates. The use of radioactive isotopes, with calcium and strontium added as chlorides, has been found effective as a means of determining loss of bituminous coatings in a stripping test. Photometric methods of measuring film densities of bituminous coated aggregates are also proving useful.

The comparison of strength characteristics of compacted bituminous paving mixtures is receiving attention and drafts of proposed test methods have been prepared, using such recognized apparatus as the Marshall machine, the Hveem stabilometer, and Hveem cohesionometer. Associated with this work is the study of methods of compacting mixtures.

Several proposed methods for the determination of angularity of fine aggregates are being studied, as well as a study of the characteristics of aggregates as affecting slipperiness of bituminous pavements. Several tentative

revisions and tentatives under the jurisdiction of the committee were approved for advancement to standard by letter ballot of the committee. A revision was accepted to the Standard Methods of Tests for Abrasion of Graded Coarse Aggregate by Use of the Deval Machine in the form of an additional grading, which will conform to that recently adopted by the American Assn. of State Highway Officials.

D-5 on Coal and Coke

Committee D-5 has decided to participate actively in the work of the International Organization for Standardization (ISO) Technical Committee 27 on Solid Mineral Fuels. Chairman W. W. Anderson will appoint a subcommittee to implement such participation. R. F. Abernethy, U. S. Bureau of Mines Experimental Station, Pittsburgh, will attend the meeting of ISO/TC 27 Working Group on Volatile Matter Determination in April at the Fuel Research Station in London. At this meeting, representatives of the participating countries will demonstrate their national methods of volatile matter determination with apparatus brought from their own countries. W. M. Bert-holf, Colorado Fuel and Iron Corp., will present a paper on current ASTM work on coal sampling at the next ISO/TC 27 Committee Meeting to be held October 5 to 9, 1953, at the British Standards Institution in London.

Committee D-5 also has decided to consider an international scientific system of coal classification proposed by the Classification Working Party of the Coal Committee of the Economic Commission for Europe.



C-8 Advisory Subcommittee. Standing, left to right: S. M. Phelps, H. N. Kraner, L. J. Tostel. Seated: W. R. Kerr, Secretary, and R. B. Sosman, Chairman.

At its meeting the committee decided to recommend to the Society in June the adoption as standard of Sampling and Analysis of Coal for Volatile Matter Determination in Connection with Smoke Ordinances (D 980), subject to letter ballot of Committee D-5.

Meetings were also held of six subcommittees whose scopes deal with pulverization, sampling, plasticity, fineness, analysis, and coke. Programs of work were outlined for consideration during the coming year.

D-6 on Paper and Paper Products

A new tentative method for determining moisture expansivity was accepted, subject to letter ballot, by Committee D-6 on Paper and Paper Products, at its Spring meeting in New York City on February 20. The method will not be limited to printing papers as originally prepared. A revision of the moisture content method (D 644) was accepted for letter ballot, this being identical with the most recent TAPPI revision of this method.

The Subcommittee on Container Board discussed at some length the G-E puncture test method, on which data covering 7000 tests have been collected. As a result of this review, it was the consensus that many features needed to be analyzed, including humidity resistance on containers, effect on adhesion, and the pin adhesion test. Additional round-robin tests will be made to establish further data on the wet immersion test and the G-E puncture test.

Decision was made to reorganize the subcommittee structure to more effectively distribute the work load of the committee. The new subcommittee organization will consist of:

- Subcommittee I—Chemical Tests of Paper
- Subcommittee II—Physical, Optical, and Microscopical Tests of Paper
- Subcommittee III—Sampling, Conditioning, and Statistical Control for Physical Testing of Container Board
- Subcommittee V—Specifications
- Subcommittee VI—Editorial

It was recommended that ASTM Committee E-1 on Methods of Testing be requested to sponsor a symposium on tension testing of nonmetallic thin sheet materials as the first step toward the development of ASTM standards for tension testing.

D-11 on Rubber and Rubber-Like Materials

ASTM Committee D-11 has been taking a very active part in the work of Technical Committee 45 on Rubber, of ISO. Several proposals under study in the ISO Committee were considered by



C-9 Executive Subcommittee. Standing, left to right: R. R. Litehiser, S. Walker, W. H. Price, H. S. Sweet, K. B. Woods, L. E. Gregg. Seated: B. Mather, Secretary, and L. W. Teller, Chairman.

Committee D-11. These will be reported upon at the next meeting of the ISO Committee to be held on June 15-23 in Paris.

Announcement was made of the appointment of J. F. Kerscher, Goodyear Tire & Rubber Co., as chairman of a new subcommittee authorized to develop specifications for rubber compounds for general application similar to the SAE-ASTM Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (ASTM D 735; SAE 10R) which have been used so successfully in the automotive and aeronautical fields.

The various ASTM specifications for rubber insulated wire and cable have been rearranged and enlarged. A new master specification covering construction details of insulated wire and cable used for the distribution of electrical energy has been developed. It covers a number of subjects now included in Specifications D 27, such as metal conductors, thickness of insulation, shielding, types of coverings, and cabling of multiple conductor assemblies. The individual purchase specifications will prescribe only the physical and electrical properties of specific types of compounds and each of these will refer to the master specification for construction details. All testing and sampling procedures for wire and cable are being consolidated into a single enlarged version of Methods D 470.

The Subcommittee on Physical Testing has decided to undertake a survey of mill roll and stock temperatures during mixing that are now being used in var-

ious rubber laboratories. The types of buffer used in preparing samples for physical testing were also discussed. A survey will be made of the various types of buffers now being used in rubber testing.

New methods for the quantitative determination of dirt, copper, and manganese in rubber, and also methods for determining the vulcanization characteristics of crude rubber were completed by the Subcommittee on Crude Natural Rubber.

Action was also taken to instruct the American delegation which will attend the meeting of ISO Technical Committee 45 on Rubber in Paris to recommend that limitations be placed on the amounts of dirt, copper, and manganese that may be present in technically classified rubber and also a more adequate characterization of the vulcanization behavior of natural rubber. The price of natural rubber today is governed to a considerable extent by the amount and type of dirt present in the rubber.

It is well known that copper and manganese accelerate the deterioration of natural rubber both in the form of crude rubber and vulcanized products. Since large amounts of rubber are kept in storage for many years before use, it is important that the amounts be extremely small. Limitations will be placed on these amounts in technically classified rubber, D 297.

The most important physical property of natural rubber for technical classification is its vulcanization behavior. Variations in this characteristic cause considerable difficulty during manufacture and may result in defective products.

The present system used in the technical classification of rubber characterizes the vulcanization behavior only in part. It was recommended that, in addition to measuring the strain or modulus of a vulcanizate cured 40 min at 140 C, the time of incipient cure and rate of cure be determined from the change in Mooney viscosity of the rubber compound as a function of time at vulcanizing temperatures.

Progress was reported in the cooperative study on correlation between oven and shelf aging of rubber. These tests cover aging periods of two, three, and four years; the next series is to be made at the end of eight years. The extensive data obtained will be analyzed by the new Subcommittee on Statistical Quality Control. This subcommittee is cooperating with Committee D-20 on Plastics in studies on the aging of plastics.

Action was taken on a revision of the four aging Methods D 454, D 572, D 573, and D 685 to require that samples be bench marked after completion of aging tests. The Aging Test by the Oven Method (D 573) will provide tests at temperatures of 100 C and for higher temperatures in increments of 50 C.

The results of a cooperative study by eight laboratories of stress relaxation tests on soft gasket stocks were presented in an extensive report by C. K. Chatten, N. Y. Naval Shipyard. The over-all objective is to develop standard equipment and procedures.

Revisions in the Test for Compression Set (D 395) will eliminate any preheating of the compression device before inserting the specimen. In view of the current widespread interest in tests at elevated temperatures, Committee D-11 may appoint a task group to study this matter and recommend temperatures to be used. In many laboratories ovens are maintained at specific temperatures and it is important to reach agreement.

The Methods for Changes in Properties in Liquids (D 471) will be rearranged. A task group will review materials that should be excluded from this test, especially porous-type materials such as cellular rubber, sponge rubber, and materials containing fiber, cork, fabric, etc.

The Subcommittee on Adhesion Tests has in preparation a round-robin test program to study proposed revisions in the Test for Adhesion to Metal (D 429).

Experience with the new Tentative Methods of Testing Adhesives for Brake Lining and Other Friction Materials (D 1205) show they give satisfactory reproducibility. They include two methods, one for evaluating the strength and permanence of bonds, and the other for

measuring the shelf life of bonded cements, tapes, adhesive film, etc.

The Subcommittee on Hard Rubber decided to study two machines for drop impact tests on asphalt battery containers. Determining failure of the asphalt containers when subjected to hot and cold cycles was discussed, and tests are to be considered.

The Subcommittee on Low-Temperature Tests studied a proposed T-R test (temperature-retraction) procedure. This determines the retraction characteristics caused by a rise in temperature after this material has been chilled in elongated condition to sufficiently low temperatures to cause it to lose practically all its elastic properties. This test is especially important with the increased use of rubber products under extreme low-temperature conditions. Retraction values give an over-all picture of low-temperature behavior including the effect of crystallization.

A report on Influence of Variations in Rotary, Dies, and Rate of Shear on Mooney Viscosity, by George E. Decker and Frank L. Rath, of National Bureau of Standards was presented to Subcommittee XXVI on Processability Tests. As a result of these studies, revisions were recommended in the Test for Viscosity by the Shearing Disk (D 927).

A progress report was presented by the Special Committee on Standard Samples which is cooperating closely with the National Bureau of Standards. One of the objectives of Committee D-11 is to establish a series of standard recipes and procedures for compounding and using in ASTM methods. The

current Methods D 15 do include a number of standard recipes. However, there is still no source available for the polymers nor for certain of the compounding ingredients.

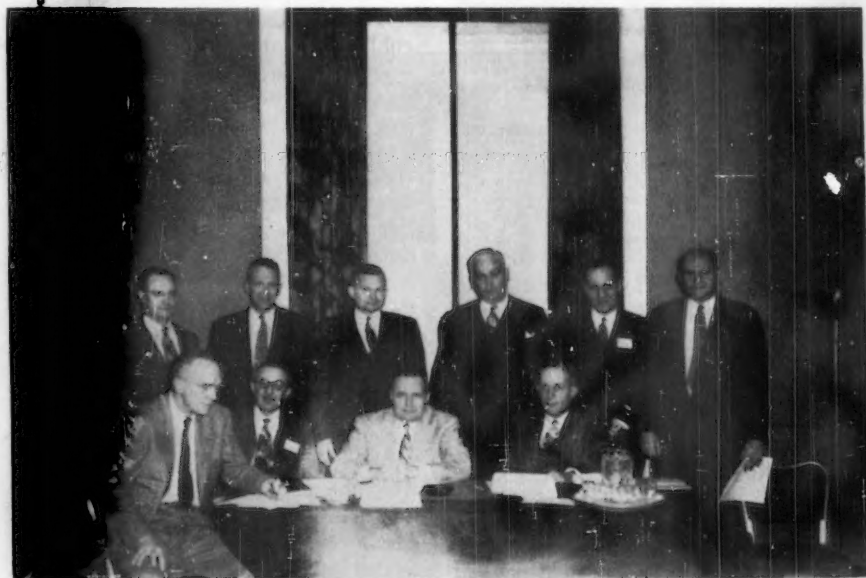
An extensive summary report was presented covering the many activities of the SAE-ASTM Technical Committee on Automotive Rubber. The Section on Automotive Vibration Insulators has under way a round-robin study of oscillograph tests. It is also preparing a practical method for testing engine mounts.

There is considerable interest in colored mounts in line with the current internal finish of automobiles. Several new methods had to be developed, such as tests for discoloration, water spotting, abrasion or scuff resistance, and evaluation of color coatings.

An extensive outdoor static exposure testing program is being carried on at 18 test locations. A wealth of data has been secured from these tests. Ozone cabinet tests have been made on the same compounds used in the outdoor exposure test and a study will be made of the correlation.

A new section is being organized to undertake work on a test procedure for impact testing of bumpers.

New specifications have been completed for rubber brake boots and revisions have also been completed in the SAE Specifications for Hydraulic Brake Cups. Important changes have been agreed upon in the Specifications for Non-Metallic Gasket Materials (ASTM D 1170; SAE 90R). These are subject to approval by letter ballot. Proposed Specifications for O-Rings will contain provisions for classes of com-



D-8 Advisory Committee. Standing, left to right: J. W. Donegan, S. H. Sallie, E. Thelen, W. F. Fair, Jr., G. W. Clarvoe, F. W. Yeager. Seated, R. R. Thurston, H. W. Greider, G. W. Robbins, Secretary and H. R. Snoke, Chairman.

pounds, methods of test, and dimensional requirements. The Subcommittee X on Physical Testing, of Committee D-11, will be asked to consider a procedure for evaluating rubber by a bend test that can be used in connection with and as a supplement to an aging test.

D-16 on Industrial Aromatic Hydrocarbons and Related Materials

Committee D-16, its Advisory Committee, and six subcommittees held meetings in Detroit. The committee is now actively functioning under its enlarged scope which reads as follows:

Scope.—Nomenclature, specifications, and methods of test of those aromatic and heterocyclic chemicals, generically classed as coal chemicals, whether derived from coal, petroleum, or any other source, by synthesis or physical separation, and used industrially either alone or as mixtures, as intermediates or solvents.

To implement its work the committee has reorganized with the following four subcommittees on specific types of materials: Subcommittee A on Monocyclic Aromatics, Subcommittee B on Polycyclic Aromatics, Subcommittee C on Phenolic Compounds, and Subcommittee D on Nitrogen Heterocyclics.

Subcommittee A has under way a cooperative study in twelve laboratories of the benzene index methods (D 1158 and D 1159) and the acid wash test of benzene samples containing cyclohexene and thiophene (D 848). Studies are being made of modifications of the methods to prevent the interference of thiophene in the determinations of bromine index of aromatic hydrocarbons. In addition, studies are also being made of a low-heat capacity electric heater that may possibly be used as a substitute for a gas burner in the distillation test (D 850).

Methods of testing naphthalene are being studied by Subcommittee B. Work to date by the Subcommittee C indicates the need for a suitable test for determining moisture in connection with which determination melting points may be adequately corrected to a dry basis. This appears to be preferable to attempting to dehydrate the sample and then determine melting point.

Methods of test for refined pyridene are being studied by Subcommittee D. Tests for ammonia and reaction to permanganate appear to need better definition as to need for such test. Whether melting point or limpid point of refined quinoline shall be specified in determining purity is also being investigated.

With this increased activity and the number of new materials and test

methods to be considered by Committee D-16, additional consumer and general interest members can be accommodated. Those interested should contact the officers of the committee.

Committee E-1 on Methods of Testing

The Subcommittee on Effect of Speed in Mechanical Testing received a report from its Task Group on Bibliography at its meeting. The task group has prepared a large number of additional references in order to bring up to date the "Partial Bibliography on Effect of Speed of Testing" reproduced in 1947. Action was taken recommending the reproduction of this important addition to the earlier bibliography so that copies can be made available to all members of the committee and to others interested.

The Task Group on Nonmetallic Materials is making a survey of the provisions for speed of testing now specified in ASTM standards for nonmetals as a basis for a program for future study of this subject.

The Subcommittee on Elastic Strength of Materials received reports from two active task groups at its meeting on March 3. The chairman of the Task Group on Elastic Constants, W. Ramberg, of the National Bureau of Standards, presented to the committee an interesting summary of methods for determining methods of elastic constants that are being used in European laboratories. Mr. Ramberg obtained this information on his visit with materials testing engineers, physicists, and metallurgists at laboratories in western Europe which he visited in the course of his trip last summer to the Eighth International Congress for Applied Mechanics held in Istanbul, August, 1952.

The Symposium on Determination of Elastic Constants, sponsored by Committee E-1 and held at the 50th Anniversary Meeting of the ASTM in June, 1952, has now been published by the Society. Copies of this Symposium are available from ASTM Headquarters. In view of the widespread interest in this subject and based on the information presented in this Symposium, action was taken recommending that the task group be requested to prepare a tentative method for determining Young's modulus.

A second task group reported on the study of definitions of terms related to Methods of Testing (E 6). Three interesting articles on these definitions presenting the viewpoint of other interested committees and individuals appeared in the ASTM BULLETIN for May and October, 1952, and January, 1953. A number of comments on the

definitions received from members of Committee E-8 on Nomenclature and Definitions were considered by the task group at its meeting. In addition, individual members of the task group made a survey of the various parts of the Book of ASTM Standards in order to obtain a list of such terms now defined in ASTM Standards. This information together with the comments received on the present definitions will be studied further during the year.

The Subcommittee on Indentation Hardness Testing

discussed the requirement in the Brinell hardness method E 10 which states that a testing machine is accepted for use over a loading range within which its load measuring device is corrected within 1 per cent. It was decided to look into this matter of precision and a survey of this subject will be made during the coming year. A task group was authorized to prepare a draft of rapid methods of ball indentation hardness tests. In developing these methods the committee will take into account the various types of such machines that are in use today. Considerable data have been obtained regarding the minimum thickness of material for use in Rockwell hardness testing. This information is to be analyzed by the task group on this subject prior to making the information available in a subsequent publication.

Consideration is being given by this subcommittee to the preparation of methods covering the use of portable indentation hardness testers.

For several years there has been a need expressed by both industry and government for the standardization of performance specifications for high-humidity enclosures for testing purposes. Several such enclosures have been developed for specific applications, particularly in standards issued by the various government agencies. The Subcommittee on Conditioning and Weathering of Committee E-1, at its meeting prepared a list of essential requirements for such enclosures for high-humidity testing. These proposed requirements will be referred to a task group for use in preparing a proposed standard. The subcommittee also decided to prepare general methods of determining relative humidity since the need for a more up-to-date method than the present ASTM Standard D 377 has been indicated.

A comprehensive report covering a survey of the testing of elastomers for stiffness at low temperatures was presented by a task group at the meeting of the Task Group on Low-Temperature Testing of Elastomers and Plastics.

(Continued on page 29)

Atlantic City Scene of Fifty-Sixth Annual Meeting

Wide Range of Materials to be Covered in Big Technical Program

METALS at low temperatures, X-ray spectrography, lateral pile load tests, concrete, electron metallography, porcelain enamel, coal sampling, and soil dynamics are among the subjects to be presented in sessions and symposiums at the 1953 Annual Meeting of the Society in Atlantic City, June 29-July 3.

Final details of the entire program will be found in the May issue of the *ASTM BULLETIN*. The week's activities will include, as in years past, the Marburg and Gillett Lectures, the President's Luncheon, and the social highlight of the meeting—the cocktail party and dinner, followed by entertainment and dancing on Wednesday, July 1.

Marburg and Gillett Lectures

FREDERICK D. ROSSINI, Silliman Professor and Head of the Chemistry Department at Carnegie Institute of Technology, has been chosen to deliver the 27th Edgar Marburg Lecture entitled "An Excursion in Petroleum Chemistry."

Dr. Rossini is Director of the American Petroleum Institute Research Laboratory at Carnegie Tech and is active in numerous national and international technical societies. He is the author of many articles and several books in his special fields of thermochemistry, chemical thermodynamics, and petroleum chemistry.

JEROME STRAUSS, Vice-President of the Vanadium Corporation of America will deliver the second annual Horace W. Gillett Memorial Lecture. His topic, "Micro Metallurgy," falls precisely within the scope of the Gillett Lecture, namely the testing, evaluation, and application of metals. Mr. Strauss has had wide experience in the alloy metals field. Long a member of ASTM he is serving as chairman of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys.

President's Luncheon

The President's Luncheon, a successful feature of previous meetings, will provide occasion for the address of the President and various recognitions and awards. American plan guests at Chalfonte or Haddon Hall will be able to

attend this luncheon without additional charge.

Hotel Reservations

Headquarters of the meeting will be Chalfonte and Haddon Hall Hotels; cooperating will be the Claridge, Cotton Manor, Morton, Lafayette, Seaside, and Senator. Enough rooms have been blocked off to accommodate all who will attend but in order that the maximum number of members can stay at headquarters, Chalfonte-Haddon Hall will severely restrict the number of rooms available for single occupancy.

Technical Papers

The following list of subjects of papers to be presented in symposiums and other sessions will give a preliminary idea of the nature and scope of the material which is being prepared for the various programs.

Symposium on Metallic Materials at Low Temperatures

Brittle failures in ships and other steel structures
Analysis of brittle behavior in ship plate
Review of ship steel committee research
Survey of brittle fracture of carbon steel plate structures other than ships
Failures in large diameter pipelines
History of interest of army in brittle failures
Theory of brittle fracture and criteria
Low temperature design criteria
Mechanical aspects of low temperature behavior in metals
Metallurgical aspects of low temperature behavior in ferrous materials
High speed motion pictures of notch bar testing
Significance of Charpy V notch bar test in evaluation of armor plate
Significance of tear test in evaluation of ship plate
Significance of Charpy V and keyhole transition curves as determined by semi-works scale structural tests
Notch bend tests for evaluating properties of weldments
Evaluation of triaxiality as affecting ductility
Effect of specimen preparation on notch-toughness behavior of keyhole Charpy specimens in transition temperature zone
Effects of size upon fracturing

Toughness and strain distribution at sub-zero temperatures
Low temperature properties of titanium
Impact properties of quenched and tempered steels

Symposium on Techniques for Electron Metallography

Washing of electron microscope replicas of surfaces
Electron diffraction examination of surface effects produced by the action of chemical etchants
Specimen polishing techniques for electron metallography
Metal-shadowing for contrast enhancement—comparison of shadow metal and shadow angle
Application of unconventional etchants for delineation of fine structure
Techniques which permit successive examinations of specific areas by electron microscopy
Comparison of positive *versus* negative plastics replicas
Comparison of silica *versus* plastic replica techniques and discussion of etchants
Techniques used in electron microscopy of aluminum alloys
Techniques for the study of precipitated carbides
Direct evaporated replica techniques of extreme interest
Recently developed film-stripping methods

Session on Methods of Atmospheric Sampling and Analysis

Properties filtering media for atmospheric dust sampling
Techniques for continuous evaluation of air contaminants
Nature and interpretation of monthly dust fall measurements

Symposium on X-Ray Spectrographic Analysis

Fluorescent X-ray spectrographic analysis
Analytical applications of X-ray fluorescence
Applications to alloy analysis
Analysis of mineral
Analysis of stainless steels

Symposium on Lateral Pile Load Tests

Battered and vertical piles, Lock No. 25, Mississippi River
Vertical fixed head hollow pile Lock No. 25, Mississippi River
Lateral loads on piles
Resistance of long hollow piles to applied lateral loads
Piles for design information
The resistance to lateral loading of single-

piles and of pile groups (results of model tests)
 Bearing piles subjected to horizontal loads
 Tests made in 1928 by the Anglo-Canadian Pulp and Paper Mills in Canada

Symposium on Soil Dynamics

Elasticity and sumping of oscillating bodies on the soil
 Loose sands—their compaction by vibro-flotation
 Performance records of engine foundations
 Macromeritic liquids
 The pressures generated in soil by compacting plant
 Pilot studies on soil dynamics
 Compaction of sand at resonant frequency
 Vibration research on road construction
 Elastic theory of soil dynamics
 Dynamic analogy for foundation soil systems
 Discontinuous model for the problems of soil dynamics
 Vibrations in semi-infinite solids due to periodic surface loading

Symposium on Radioactivity in ASTM Work

Principles of radioactivity and its uses
 Applications of radioactivity in ASTM work
 Laboratory design, availability of isotopes, health, safety and personnel training
 Instrumentation
 Demonstration period (to include several short demonstrations of the use of radioactivity in typical experiments which might be of interest to ASTM)
 Management's view of radioactivity
 AEC movie on methodology
 Joint panel of previous speakers with other selected ASTM Committee members

Exhibit.—A small exhibit of representative instruments and equipment is being planned for continuous showing through-

The Complete Provisional Program of the 1953 Annual Meeting will appear in the May issue of the ASTM Bulletin.

out the day. These exhibits may include various types of counting equipment such as GM, ionization chamber, flow and scintillation counters, cutie pies, and other similar instruments; personal protection devices such as: film badges, pocket dosimeters, film rings; shielding materials such as lead bricks, lead storage and shipping containers, lucite shields and glove boxes; industrial control instruments such as back-scatter gages, liquid-level, density and transmission gages, etc.

Significance of Tests of Concrete

Determination of pore characteristics of aggregates
 Chemical reactions of aggregates in concrete
 Thermal expansion tests on concrete, neat cement and aggregates
 Evaluation of curing compounds for portland cement concrete
 Pulse velocity testing of concrete
 Sulfate resistance of concrete
 Wear tests of concrete

Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials

Industrial processing of high temperature ceramic coatings
 Acid resisting properties
 Study of abrasion resistance
 High temperature ceramic coatings for aircraft power plants
 Torsion testing as an aid in process control
 Laboratory evaluation of ceramic coatings
 Application of coatings to high temperature components of a jet engine

Functional use of glass as a coating for steel
 Tension tests of porcelain enameled steels
 The effect of temperature on the electrical resistivity
 Resistance of porcelain enamels to weathering
 The chemical resistance of glassed-steel process equipment
 Strengthening effect of porcelain enamel on sheet iron as indicated by bending tests
 Resistance of porcelain enamels to surface abrasion

Technical Papers—Metals

Properties of high strength rivet steel
 Influence of strain-rate and temperature on mild steel in torsion
 Directional strength in straight- and cross-rolled strip steel
 Corrosion of beryllium copper strip in sea water and marine atmospheres
 Range of stress on fatigue strength of SAE 4340 steel in bending and torsion
 Static and fatigue properties of carbon, silicon, and high-strength low-alloy steel
 Damping, elasticity, and fatigue of un-notched and notched N-155 at room and elevated temperatures
 Fatigue properties of unnotched and notched aluminum alloys
 Influence of grain size on fatigue notch-sensitivity
 Elevated temperature fatigue properties of SAE 4340 steel
 Investigation of prot accelerated fatigue test
 Investigation of time-temperature parameters
 Influence of notches on stress-rupture characteristics of heat-resisting alloys
 Notch behavior of steels
 Notch effect on a Cr-Mo-V steel
 Creep of ferritic steels containing 5 to 17 per cent chromium
 Reproducibility of Charpy and tear-test data on semikilled steels
 Tension impact testing of sheet metals
 Delayed yielding annealed low-carbon steel under compression impact
 Comparison of twenty impact testing machines in the 20-30 ft-lb range

Concrete Session

Determination of compressive strength of concrete by sonic properties
 Prediction of concrete durability from thermal tests of aggregate
 Resonant frequency and velocity tests on concrete subjected to freezing and thawing
 Effect of sand grading on workability of masonry mortars and amount of cracking at mortar joints in brick buildings
 Elastic constants of orthotropic materials

Miscellaneous

Asphaltic pavement design methods
 High-speed torsion testing equipment for high polymers
 Three years outdoor weather aging of plastics
 Practical precision of methods of testing for dissolved oxygen in waters of high purity



Daily News Record

A highlight of the New York meetings of Committee D-13 on Textile Materials in March was the award of the H. De Witt Smith Memorial Medal to Herbert J. Ball, Head of the Department of Engineering, Lowell Textile Institute. At the speakers' table, standing, left to right: S. J. Hayes; H. J. Schiefer, 1951 Medalist; Ruth S. Honeycutt, Prof. Ball's daughter; Prof. Ball; A. G. Ashcroft; R. T. Kropf. Seated: W. D. Appel; G. E. Hopkins; Esther J. McMaster, Prof. Ball's daughter; F. Bonnet, 1952 Medalist; W. H. Whitcomb.

Research in Effect of Notches at Elevated Temperatures Described in Twelve Papers of New Symposium

RECENT interest in the effect of notches on metals at elevated temperature led to the development, by the Joint ASTM-ASME Committee on Effect of Temperature, of a Symposium on Strength and Ductility of Metals at Elevated Temperatures—with Particular Reference to Effects of Notches and Metallurgical Changes. This symposium, which was held at the 50th Anniversary Meeting of ASTM in New York City has now been published together with discussion, by the American Society for Testing Materials.

In the 12 papers comprising the symposium are presented and discussed the results of current research on effect of notches on metals at elevated temperatures under either static or dynamic loading. They also deal with another aspect of the behavior of metals at high temperatures—the metallurgical changes which occur during heating at elevated temperatures, and the effect of these on strength and ductility.

Titles and authors of the papers are as follows:

A Survey of Embrittlement and Notch Sensitivity of Heat Resisting Steels—G. Sachs and W. F. Brown, Jr.

Effect of a Notch and of Hardness on the Rupture Strength of Discaloy—F. C. Hull, E. K. Hann, and H. Scott

1 Picture—10,000 Words

THE old Chinese proverb that one picture is worth 10,000 words is heartily endorsed by the Papers Committee who would like to invite BULLETIN readers to send in for publication any pictures they have taken which they think might be of interest to the ASTM membership. This category would include, for example, pictures taken at District and committee meetings, technical photographs, industrial scenes, equipment, and installations, etc.

Influence of Sharp Notches on the Stress-Rupture Characteristics of Several Heat-Resisting Alloys—W. F. Brown, Jr., M. H. Jones, and D. P. Newman

The Effect of Grain Size Upon the Fatigue Properties of 80, 1200, and 1600 F of the "Precision-Cast" Alloy X-40—P. R. Toolin

Investigations Into the Effect of Notches on the Results of Long-Time Rupture Tests at Elevated Temperatures—W. Siegfried

Theory of Time-Dependent Rupture and Interpretation of Some Stress-Rupture Data—D. N. Frey

Effect of Notch Geometry on Rupture Strength at Elevated Temperatures—E. H. Davis and M. J. Manjoine

Notch Rupture Tests of Inconel X and Nimonic 80A—D. E. Furman and A. M. Talbot

An Experimental Study of the Strength and Ductility of Steel at Elevated Temperatures—J. Glen

Effect of Sigma on Strength and Ductility of 25 Cr, 20 Ni Steel—G. V. Smith and E. J. Dulis

Recovery and Creep in an Alloy Steel—H. A. Lequear and J. D. Lubahn

The Structure and Properties of Stainless Steels after Exposure at Elevated Temperatures—A. B. Wilder and E. F. Ketterer

Copies of this symposium, *Special Technical Publication, No. 128*, can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia. It is bound in heavy paper cover and is priced at \$3.25; members' price is \$2.50.

Papers on Conditioning and Weathering Cover Broad Interests in Materials Testing Field

A WIDE range of the materials of engineering with which ASTM is concerned require temperature and humidity conditioning prior to or during testing. Recognition of the importance of having authoritative information on these requirements led ASTM Committee E-1 on Methods of Testing, through its Subcommittee 14, to develop for the 1952 Annual Meeting a Symposium on Conditioning and Weathering, which has just been published.

As stated in Robert Burns' Introduction, the purpose of the symposium is to

"...provide a broad picture of the art in terms of particular materials so that a technologist in paper, for example, will be exposed to the latest thinking in textiles, plastics, adhesives, coatings, etc.—thus not only advancing the art for all industry but minimizing duplication within the Society."

Following the Introduction are ten papers covering broadly the several aspects of this most complex engineering problem:

Fundamentals of Atmospheric Elements—B. C. Haynes

Air Conditioning in the Manufacture and Testing of Textiles—R. H. Brown

Conditioning and Weathering of Paper—William R. Willets

Conditioning and Weathering of Adhesives and Plastics—F. W. Reinhart

Weathering of Some Organic Coatings—E. J. Dunn, Jr.

Weathering Tests on Metallic Coatings—William Blum

Laboratory Air Conditioning—A. E. Stacey, Jr.

Development of a Moisture Resistance Test—C. P. Lascaro

Outdoor Exposure Testing on Racks and Test Fences—K. G. Compton

Accelerated Weathering Devices—R. H. Sawyer

Including discussions, the publication totals 103 pages. List price for the complete symposium, bound in heavy paper cover, is \$2.25; price to members is \$1.70. Copies can be purchased from ASTM Headquarters, 1916 Race St., Philadelphia, Pa.

Compilations of Standards

Copper and Copper Alloys

The new edition of the ASTM Copper and Copper Alloys compilation is now available, offering in compact, handbook form the widely used specifications and tests developed by ASTM Committee B-5 on Copper and Copper Alloys (castings, rods, bars, forgings, wire, pipe and tubes, plate, sheet, and strip); the several specifications on copper and copper alloy wires for electrical conductors (Committee B-1); and standards on lake and electrolytic copper, lead, nickel, etc. (Committee B-2); and various tests for metals.

Altogether about 113 standards are included in this compilation, totaling 550 pages. It is available in both heavy paper cover and cloth binding. For the paper cover edition, list price is \$4.75; members' price, \$3.50. For the cloth-bound edition add 65 cents to these prices. Copies can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa.

Soaps and Other Detergents

The compilation of ASTM specifications and standards developed by Committee D-12 on Soaps and Other Detergents is now available in convenient reference form.

The 26 specifications cover, among other things, bar, chip, powder, and toilet soaps; borax, caustic soda, sodium, and trisodium.

The 9 methods included in this publication provide for sampling and analysis of soaps, synthetic and alkaline detergents, surface-active agents, metal cleaning compositions, and aluminum cleaners. There are also Definitions of Terms Relating to Soaps and Other Detergents.

In addition, four appendices, published as information only, give four Proposed Methods on Surface and Interfacial Tension of Solutions of Surface-Active Agents; Rinsing Properties

of Metal Cleaners; Buffering Action of Metal Cleaners; and Total Immersion Corrosion Test for Soak Tank Metal Cleaners.

Bound in heavy paper cover, copies of this 144-page compilation can be purchased from ASTM Headquarters for \$2.25. The price to members is \$1.70.

Plastics

The more than 100 standard specifications and tests developed by ASTM through the work of Committee D-20 on Plastics are compiled in one convenient volume, providing for both producers and users of plastics an important source of valuable data.

Specifications cover the various families of plastics—phenolics, cellulose, ureas, vinyls, etc. Tests include those for bond strength, brittleness, density, diffusion, flammability, haze, mar resistance, stiffness, and others. There are also several standards on nomenclature and definitions.

Copies of this 700-page book in heavy paper cover, can be bought from ASTM Headquarters, for \$5.25; the price to members is \$4.

Light Metals and Alloys, Cast and Wrought

The third edition of the compilation sponsored by Committee B-7 on Light Metals and Alloys has just been published. It contains not only specifications and methods of test for ingots, castings, and wrought products of aluminum and magnesium and their alloys but also those for light-metal alloy die castings and those for aluminum wire and cable for electrical purposes.

In order to make these standards as useful as possible, methods of chemical analysis have been added.

In all, there are 36 specifications and methods of test totaling 160 pages.

Copies of this timely compilation, bound for ready reference in heavy paper cover, can be obtained from ASTM Headquarters, for \$2.50; price to members, \$1.85.

Electrical Insulating Materials

This publication sponsored by ASTM Committee D-9, brings together under one cover all the important standard specifications, together with testing procedures, for electrical insulating materials. Included in this edition are standards on insulating varnishes, paints, lacquers; molded materials; plates, sheets, tubes, and rods; mineral oils; ceramic products; solid filling and treating compounds; electrical tests; insulating papers; mica; rubber, textiles, conditioning, etc. This publication also contains several special reports on the significance of various tests.

Altogether there are 95 standards aggregating more than 700 pages. Copies in heavy paper cover can be purchased from ASTM Headquarters, for \$5.25; members' price, \$4.

Corrections

WE HAVE been advised by R. K. Bernhard, chairman of Subcommittee R-9 of ASTM Committee D-18 on Soils for Engineering Purposes that the statement about R-9 activities appearing on p. 26 of the February ASTM BULLETIN is partially incorrect. Mr. Bernhard stated that the subcommittee did not initiate the research projects described there but rather had received reports from its members on results of these projects.

In the Symposium on Determination of Elastic Constants the headings for the lower half of Table II, which appears on p. 17, were omitted. These headings, reproduced below, could be cut and pasted on p. 17 or a corrected insert sheet may be obtained by writing to the Society.

TABLE II.—SUMMARY OF TEST RESULTS AT ROOM AND ELEVATED TEMPERATURES—Continued

| Temperature, deg Fahr | Steel K 5 Cr, ½ Mo, Ti | | Steel L 9 Cr, 1 Mo | | Steel M 12 Cr | | Steel N 17 Cr | | Steel O 27 Cr | | Steel P 18 Cr, 8 Ni (304) | | Steel Q 18 Cr, 8 Ni Mo (316) | | Steel R 18 Cr, 8 Ni, Ti (321) | | Steel S 18 Cr, 8 Ni Cb (347) | | Steel T 25 Cr, 12 Ni (309) | | Steel U 25 Cr, 20 Ni (310) | |
|--------------------------|------------------------------|---|-----------------------|---|------------------|---|------------------|---|------------------|---|---------------------------------|---|------------------------------------|---|-------------------------------------|---|------------------------------------|---|----------------------------------|---|----------------------------------|---|
| Specimen..... | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |

1952 Marburg Lecture— McMaster on Nondestructive Testing

THE Twenty-sixth Edgar Marburg Lecture, presented by Robert C. McMaster at the Fifty-fifth Annual Meeting of the Society in June of last year, has recently been published. Entitled "Nondestructive Testing," this lecture deals thoroughly with all the various phases of that subject, providing information that will be of value and interest to everyone connected in any way with nondestructive testing.

McMaster explains first that "the art of nondestructive testing includes all possible methods of detection or measurement of the properties or performance capabilities of materials, parts, assemblies, structures, and machines, which do not damage or destroy their serviceability." Nondestructive tests are of three general types: (1) those involving transmission of energy, (2) those involving transport of matter, and (3) those involving combinations of matter transport and energy transfer in their probing media. In this lecture, each kind is considered separately and examples of the numerous methods within each division are given.

A part of the paper is devoted to a study of the characteristics of nondestructive tests, showing how this type of test differs from destructive tests. The advantages and the limitations of both groups are presented side by side in a table for quick comparisons. Although the advantages of nondestructive tests outweigh those of destructive tests, it is important to remember that "both types of tests are essential in materials testing." After establishing the existence of a flaw or defect by a nondestructive test, it is then necessary to measure its influence upon the serviceability of the test object; this latter step is ordinarily done by making destructive tests. In order for a nondestructive test to be reliable, then, there must be a proved correlation between the property measured and the strength or serviceability property being predicted from the measurement.

This latest Edgar Marburg lecture fulfills the purpose of describing "outstanding developments in the promotion of knowledge of engineering materials." Robert McMaster, supervisor

1942 YEAR BOOK?

A FORMER officer of the Society is looking for a copy of the 1942 ASTM Year Book, the only issue missing from his file. If anyone who has a copy for which he has no further use, will send it to Headquarters, 1916 Race St., Philadelphia, we will see that it is forwarded to the member.

of the Electrical Engineering Division of Battelle Memorial Institute, is a recognized authority in the field of nondestructive testing, as is apparent from his competent handling of the subject in this paper.

Containing 76 pages, 44 figures, and a bibliography of over 150 references, the printed lecture is available at \$1.50; \$1.15 to members.

Steel Structures Painting Specification

NINE TENTATIVE surface preparation specifications developed by the Steel Structures Painting Council are now available in published form. Their purpose is to establish current good practice in the cleaning of structural steel surfaces prior to painting. They were prepared and revised in collaboration with representatives of steel fabricators, contractors, railroads, highway departments, paint manufacturers and contractors, and other interested organizations. It is intended that these specifications be included in contracts by reference to their title and number. Suggestions for improvement should be addressed to the Secretary, Steel Structures Painting Council.

The specifications cover: No. 1, Solvent Cleaning; No. 2, Hand Cleaning; No. 3, Power Tool Cleaning; No. 4, Flame Cleaning of New Steel; No. 5, Blast Cleaning to "White" Metal; No. 6, Commercial Blast Cleaning; No. 7, Brush-off Blast Cleaning; No. 8, Pickling; No. 9, Weathering and Cleaning.

Preparation of these specifications was carried out by the Research Committee composed of Chairman J. O. Jackson, representing the American Institute of Steel Construction; J. Bigos, Secretary, SSPC; A. J. Eickhoff, American Society for Testing Materials; A. J. Liebman, National Association of Corrosion Engineers; N. W. Morgan, Bureau of Public Roads; M. A. Roose, American Railway Engineering Assn.; E. J. Ruble, Assn. of American Railroads.

Copies of a complete set of 9 specifications can be obtained from the Council, 4400 Fifth Ave., Pittsburgh 13, Pa., for \$1; single copies, 25 cents each.

Technical Papers Published

It is planned to include in each issue of the ASTM BULLETIN a list of the technical papers which have recently appeared.

These lists largely comprise papers contained in the newer Special Technical Publications although some of them are advance printing of individual papers that are to appear in the *Proceedings*.

Symposium on Direct Shear Testing of Soils

Introduction—F. J. Converse
The Place of the Direct Shear Test in Soil Mechanics—D. M. Burmister
Use of Direct Shear Tests in Highway Design—E. S. Barber
Use of Direct Shear Tests in Earthwork Projects Under Construction—R. R.

Proctor

The Strength of Gravel in Direct Shear—R. G. Hennes
A Direct Shear Test with Drainage Control—D. W. Taylor
The Use of the Direct Shear Testing Machine in Foundation Engineering Practice—F. J. Converse

Symposium on Testing Adhesives for Durability and Permanence

Effect of Specimen Structure in Permanence Tests on Wood Adhesives—Robert P. Hopkins, Rohm and Haas Co.
Glass Adhesives—Frank Moser, Pittsburgh Plate Glass Co.
Current Investigations of the Durability of Woodworking Adhesives—R. F. Blomquist, Forest Products Laboratory

Nondestructive Determination of Mechanical Properties and Deterioration of Adhesives—Albert G. H. Dietz, Herman N. Bockstruck, and George Epstein, Massachusetts Institute of Technology

Field and Laboratory Tests for Durability and Permanence: Adhesives Belonging to the Rubber-Resins Systems—J. F. Anderson and L. F. Fiedler, The B. F. Goodrich Co.

Symposium on Fatigue with Emphasis on Statistical Approach

The Statistical Nature of the Fatigue Properties of SAE 4340 Steel Forgings—J. T. Ransom and R. F. Mehl
The Statistical Behavior of Fatigue Properties and the Influence of Metallurgical

Factors—E. Epremian and R. F. Mehl
A Statistical Interpretation of the Effect of Understress on Fatigue Strength—E. Epremian and R. F. Mehl

Fatigue Properties of Large Specimens with Related Size and Statistical Effects—Oscar J. Horger and Harry R. Niefert

Recommendations of Committees B-1 and D-14 Approved by Administrative Committee on Standards

Wires for Electrical Conductors:

A TENTATIVE Method for Determination of Cross-Sectional Area of Stranded Conductors (B 265) was approved by the Administrative Committee on Standards on March 10, 1953.

Development of this weight method by Committee B-1 came in response to a recognized need made apparent by the fact that the variety of methods now in use give varying results which are difficult to check. Some of these methods are time consuming and erratic. The tentative ASTM method is comparatively simple and capable of giving results which can be readily duplicated.

Adhesives:

Approval was given by the Standards Committee on March 17, 1953, to a revision of Tentative Method of Test for Strength Properties of Adhesives in Shear by Tension Loading, Metal to Metal (D 1002).

The principal reason this change was recommended by Committee D-14 was to reduce the length of the overlap from the present 1 in. to a length that would not result in excessive stressing of certain metals, such as 24 ST-3 clad aluminum alloy, when new modern structural adhesive bonding processes are used.

Latest Approvals by Standards Committee

Tentative Method

for Determination of Cross-Sectional Area of Stranded Conductors (B 265 - 53 T) (Approved March 10, 1953)

Revision of Tentative Method

of Test for Strength Properties of Adhesives in Shear by Tension Loading Metal to Metal (D 1002 - 53 T) (Approved March 17, 1953)

D-7 Launches Wood Pole Testing Program

ENTHUSIASTIC support and interest in the wood pole testing program was expressed at the meeting of Committee D-7 on Wood, held at the Palmer House, Chicago, Ill., on March 16 and 17. This very comprehensive research program was officially launched at the meeting, at which time prepared summaries and a complete report covering the various details and background of the project were made available. A nation-wide organization was announced, based on regional committees, which will contact pole producers, treaters, and users for cooperation in underwriting the cost of this program, which is estimated at \$150,000, covering a two-year period, the time anticipated for completion of the research program.

The principal objectives of the program will be to obtain reliable data on the strength of full-size poles to provide a accurate design basis for the principal pole species; to determine the effect on the strength of poles of knots, spiral grain, checks, and splits; to establish a relationship between tests of small clear specimens with tests of full-size poles; and to determine the effect of accepted preservative treating processes on the strength of poles. Complete literature on this program may be obtained from ASTM Headquarters.

Proposed revisions of the Tentative Specification for Round Wood Piles (D 25) were discussed at some length, with certain changes being approved for letter ballot. These include revisions in the sections pertaining to unsound knots, the minimum circumference and diameter of Class A piles, out-of-round-

ness requirements, and in respect to trimming of clean peeled piles. With these changes, this specification was recommended for continuation as a tentative. It was announced that the results of research studies at the Forest Products Laboratory, covering stress grades and working stresses of structural timber, are now available and will serve as the basis for a revision of the Tentative Methods for Establishing Structural Grades of Lumber (D 245).

In the field of wood preservatives, two new proposed specifications, with companion test methods, were accepted, subject to letter ballot of the committee. These will cover copperized chromated zinc chloride, and pentachlorophenol, respectively. Minor revisions in the Specifications for Creosote (D 390) and Creosote-Coal Tar Solution (D 391) were accepted for immediate adoption. These changes are in line

with corresponding specifications developed by the American Railway Engineering Assn. and American Wood-Preservers Assn.

The first attempt to develop standards in the field of modified wood and wood-base materials is a proposed specification and a test method on compreg as a material. The first draft will be revised, based on discussion at the meeting, for further consideration of the subcommittee. The first meeting of the newest activity of Committee D-7, structural fiber boards, was held with a very representative attendance. The first efforts of this group will be to develop standard definitions of terms relating to fiber boards and to establish a scope within which it will operate. It is felt that the activities of this subcommittee will be confined mainly to developing standards on strength and mechanical properties of fiberboard.

Standardization—the Common Denominator

"I HAVE always had an engineer's respect for standardization. . . . Fifteen years ago I said, 'Of all the characteristics of American management, it seems to me that the application of the principles of standardization is most outstanding. In utilization of the principles of standardization we have led the world.' Today, as a result of my experiences of the past two years in Europe I am inclined to think I understated the case. Standardization, in the broadest sense of the term, seems to me to be the common denominator in working out a solution to many of the economic and military problems that face the nations of the North Atlantic Treaty Organization."

—William L. Batt in *Standardization*



APRIL 1953

NO. 189

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

For Company Members Only

WHILE this article is addressed primarily to company members, it will no doubt be of interest to a number of those holding individual membership in the Society, particularly those who may be contemplating changing an individual membership to a company membership. There has been considerable speculation in a number of the Society's technical committees as to whether there is complete understanding on the part of company members concerning their privileges with respect to membership on technical committees, namely, that membership on an ASTM technical committee is not confined to the official company representative in the Society. Various individuals who may be expert in particular fields can be selected to represent the company membership on different ASTM committees

(provided, of course, that the membership on the technical committee has been properly cleared in that committee).

This applies not only to having different individuals serve on various committees but may also apply to the selection of the particular individual to serve on individual subcommittees. In these committees where this matter has been discussed it has been pointed out that the committees' work will be furthered most advantageously if the individual serving on the subcommittee is the one who is best informed so far as the company's operations are concerned. Also the company would benefit more directly and find its membership more valuable by seeing to it that its participation in the committee's work is through its special experts. It is accordingly suggested that company members review their representation on tech-

Nominations for Officers

THE Nominating Committee met in Detroit on March 5 to select nominees for the ASTM offices of President, Vice-President, and Board of Directors.

In accordance with the By-laws of the Society, the Nominating Committee, whose personnel was listed in the October 1952 BULLETIN, has announced the following nominations:

For President (term 1 year):

L. C. BEARD, JR., Assistant Director, Socony-Vacuum Laboratories, Socony-Vacuum Oil Co., Inc., 26 Broadway, New York, N. Y.

For Vice-President (term 2 years):

C. H. FELLOWS, Director, Engineering Laboratory and Research Dept., The Detroit Edison Co., 2000 Second Ave., Detroit 26, Mich.

For Directors (term 3 years):

N. A. FOWLER, Director of Sales and Research, General Box Co., 1825 Miner St., Des Plaines, Ill.

R. T. KROFF, Vice President, Industrial

Thread Div., Belding Heminway Corticelli, 1407 Broadway, New York, N. Y.

T. F. OLT, Director, Research Laboratories, Armco Steel Corp., Middletown, Ohio

J. R. TOWNSEND, Director of Material and Standards Engineering, Sandia Corp., Sandia Base, Albuquerque, N. M.

K. B. WOODS, Associate Director Joint Highway Research Project and Professor of Highway Engineering, Purdue University, Lafayette, Ind.

Acceptance of the nomination has been indicated in writing by each of the nominees. The By-laws provide that "further nominations, signed by at least 25 members, may be submitted to the Executive Secretary in writing by May 25, and a nomination so made, if accepted by the member nominated, shall be placed on the official ballot" which "shall be issued to members between May 25 and June 1."

—John K. Rittenhouse—

THE Staff and members of the Society were saddened by the death on March 13, 1953, of John K. Rittenhouse, ASTM Treasurer Emeritus.

Mr. Rittenhouse was well known to many members of the Society over his long period of service as a member of the Staff.

He retired April 15 of last year after 43 years of devoted service to the Society, as Assistant Treasurer from 1919 to 1946, and subsequently as Treasurer.

Following his retirement, Mr. and Mrs. Rittenhouse had made their home in Rochester, N. Y. Funeral services and burial were in Philadelphia, Pa.

In addition to his wife, the former Margaret Bell, Mr. Rittenhouse is survived by a son, C. Gordon, of Rochester, and a daughter, Katherine R. Long, of Short Hills, N. J.

nical committees and sub-committees to see if this is properly held in each instance.

There is one further aspect in connection with the participation of company members in ASTM committees, namely while a number of these companies may be primarily interested so far as the product they manufacture is concerned, they are at the same time consumers of many items. This raises the question as to whether these companies, even though represented on committees covering products in which they are primarily interested, also have representatives serving on other technical committees covering products of which they are consumers.

Parking Space Available to Members Visiting Headquarters

WE SHOULD like to remind members who have occasion to visit Headquarters that there is a limited amount of parking space available in the Society-owned lot on Cherry St. immediately behind the Headquarters Building.

Since parking lots in the vicinity of 1916 Race St. are usually crowded and street parking is severely limited, members will find it convenient to use the parking facilities while they are attending meetings at Headquarters. The parking area is enclosed; the key can be obtained at the reception desk.

To the Editor

Dear Sir,

The chief purpose of the photographic illustrations which you publish with articles is to convey information more rapidly and no less accurately than it could be given in the text. Quite frequently, by failing to indicate the scale of a picture, the photograph fails in this aim....

The photographer's difficulty is quite real and common. Perhaps your Society could do something to help photographers in this matter. The reason for the difficulty is that the illustrator of a scientific article is so familiar with his subject that he cannot imagine how unfamiliar it looks to some readers; this lack of imagination is most severe in specialists, such as the writers of letters in "Nature" who leave out information such as magnification more frequently than authors of longer scientific articles. This may be a sort of blindness induced by specialization. It might offer a basis for help if I mention a few clues used by British photographers in showing the scale of photographs. One of the best is a piece of material 10 cm long, with alternate cm's on one edge marked in black on a white background, and on the other edge the alternate inches blackened; this is very helpful in photographs of large apparatus and can be identified by both metric and inch-minded readers. It is not really simpler to photograph a steel

scale engraved in metric and inch units, since such scales are very difficult to light evenly, and usually the details escape reproduction in a block. Some English photographers include a coin in the picture; this is a mistake if one uses a round coin since they occur in a variety of sizes. Fortunately we have a twelve-sided coin which is not ambiguous, but it would not convey a clear idea to foreign readers. For large machines one often includes a figure beside the object; for small machines I have seen a watch used, but this is only semiquantitative since watches vary in diameter. Stating the reduction of scale as a fraction is also sometimes done, but only a very scientific periodical has editors who are sufficiently conscientious to correct these fractions when the photographs are further reduced in reproduction.

I do not think that the subject is one which merits setting up a committee and drafting a standard, but I do think that a Society such as the ASTM which fosters an interest in photography by having competitions for photographers would be able to do some good, by publishing a few letters on the subject of "How to indicate the scale of a picture."

Yours faithfully,

ERNEST H. S. VAN SOMEREN
(F. Inst. P., A.R.P.S.)

Comments or suggestions about the problem discussed in this letter will be welcomed for publication. Readers who would like to present their views or stimulate expression of other ideas on any pertinent technical subject are invited to send them along to the Editor.

100 Years of Engineering Progress with Wood

THE printed Proceedings of the Wood Symposium, entitled "One Hundred Years of Engineering Progress with Wood" have been released by the Timber Engineering Co., Washington, D. C. A limited number of copies of this publication are available from that office.

This publication has been prepared in a very complete manner and pleasing style with numerous illustrations. The Symposium was sponsored jointly by the AREA, ASTM, Structural Division of ASCE, and the Wood Industries Division of ASME. It consisted of five sessions, arranged so as to group the papers into the various phases of testing and research, engineering, and technical development.

Copies may be obtained without charge by writing to Timber Engineering Co., 1319 Eighteenth St., N. W., Washington 6, D. C.

Gaillard Seminar June, 1953

JOHN GAILLARD, mechanical engineer on the staff of the American Standards Assn. and lecturer at Columbia University, will hold his next five-day private seminar on industrial standardization from June 22 through 26, 1953, in the Engineering Societies Building, 29 W. 39 St., New York City.

The Gaillard Seminars were started in 1947 upon request from companies for assistance in the organization of their standardization work and the training of their men in writing standard specifications.

Further information may be secured from Dr. John Gaillard, 400 W. 118 St., New York 27, N. Y.

Sauveur Memorial Lecture by H. H. Lester

THE Fourteenth Albert Sauveur Memorial Lecture before the Boston Chapter of the American Society for Metals, was given this January by H. H. Lester, who is well known in ASTM through his chairmanship of the New England District Council and his activity in Committee A-1 on Steel and E-7 on Non-Destructive Testing.

In the lecture, Dr. Lester who is a Physicist at Watertown Arsenal, Watertown, Mass., referred to the initial plans for a memorial to Professor Sauveur which were begun by a group who were attending the 1939 Annual Meeting of ASTM in Atlantic City.

According to Dr. Lester, it was at these seaside luncheon meetings that the idea developed which resulted in the Sauveur Memorial Room in ASM Headquarters in Cleveland.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and locations of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

| DATE | GROUP | PLACE |
|----------------|---|----------------------|
| April 20-21 | B-1 on Wires for Electrical Conductors | Cleveland, Ohio |
| April 20-22 | B-9 on Metal Powders and Metal Powder Products | Cleveland, Ohio |
| April 22-23 | D-10 on Shipping Containers | Chicago, Ill. |
| April 29 | C-14 on Glass and Glass Products | New York, N. Y. |
| June 25-26 | B-4 on Electrical Heating, Resistance, and Related Alloys | Atlantic City, N. J. |
| June 29-July 3 | ASTM Annual Meeting | Atlantic City, N. J. |

DISTRICT ACTIVITIES

Maxwell Speaks at Birmingham

150 at Steel Meetings Hear ASTM President

ABOUT 150 members and committee members of ASTM and members of the American Chemical Society and American Society for Metals were present at the first local meeting of the Society in Birmingham, Ala., when the Society's President, H. L. Maxwell, spoke on "Chemical Developments and Engineering Materials." This session was held during the meeting of Committee A-1 on Steel at the Tutwiler Hotel, extending from February 3 through the 5th. A majority of those in attendance were Steel Committee members.

That technical leaders in the Birmingham area have occupied an important place in the ASTM activities was evident from the group at the head table. Two former directors, O. U. Cook, now retired, but formerly with Tennessee Coal and Iron, and J. T. MacKenzie, Vice-President, American Cast Iron Pipe Co., were there, as was J. R. Trimble, currently a director, also with Tennessee Coal and Iron. Presiding at the dinner was H. P. Bigler, very active in the Steel Committee when he was chairman of Subcommittee V on Steel Reinforcement Bars, now Executive Vice-President of the Birmingham Chamber of Commerce. The officers of Committee A-1 were there too, namely, Messrs. Mochel, Oatley, Stitt, and Worth. Past-President A. E. White, attending his first committee meeting for many months, was in the group and the Staff was represented by Executive Secretary R. J. Painter and J. W. Caum, Assistant Technical Secretary. Representing the American Chemical Society, one of the joint sponsors, was J. L. Kassner, Chairman of the local section, from the University of Alabama; and E. A. Brandler who is Secretary of the American Society for Metals and Metallurgical Engineer with Electro-Metallurgical, represented his group, another joint sponsor. Flanking Mr. Bigler were President Maxwell and Past-President J. G. Morrow, Metallurgical Engineer, The Steel Company of Canada, Ltd.

Following greetings by Mr. Bigler on behalf of Birmingham, and the introduction of those at the head table, Executive Secretary Painter spoke. He ex-

pressed appreciation for the fine hospitality extended in this southern industrial city, referred to certain arrangements where there is a joint interest on the part of ACS, ASM, and ASTM, and commented on certain other ASTM activities mentioning the studies involving Headquarters expansion and co-operation with federal authorities. He noted that 1952 had been an unusual and in some respects a very trying year, but that the splendid interest of the members and the fine support of the directors and officers of the Society had kept it going forward in its numerous activities.

President Maxwell supplemented his talk on the significance of engineering materials and chemical developments with slide exhibits. He gave several examples of cost appraisal which showed either by higher production or absence

of shutdown that quite frequently higher materials costs justified themselves. He referred to interesting phases of development for some of the newer synthetics such as Orlon and Dacron and also cited nylon, its discovery and subsequent development, as a most satisfying project.

President Maxwell is speaking at other district meetings and his talk will be published in a later issue.

The holding of meetings of this kind in centers where ASTM has not previously held them has a special interest. Old friends get together and the attention of the industries in the area is directed to the Society. Speaking of old friends, it was noted that Messrs. Cook and Oatley, in adjoining seats at the head table, had some 60 or 65 years ago gone to grammar school together in Rochester, N. Y. Another old timer, Grant Shoop, formerly of T.C.I., had been first associated with Mr. Cook a "few" years back, the date 1904 being mentioned.

Eisenhower . . .

"Youth and Engineering"

Dwight D. Eisenhower, prior to his election to the presidency, made a statement to the American Society for Engineering Education which appeared in the November, 1952 *Journal of Engineering Education*. Excerpts from these significant remarks appear below.

"... I want to do everything in my power to safeguard and improve the opportunity for young Americans. They must have the blessings of self-reliance and freedom. They must have, so far as it is within our power, the assurance of a secure and peaceful world.

"The value of engineering and engineering education in securing this peaceful world cannot be overemphasized. The engineer has made many contributions in developing our national economy and our military preparedness program. In our highly complex technological society, the engineer is the creator of our modern tools of production. His efforts are largely responsible for America's great productive capacity and industrial superiority.

"During the past World War, I saw engineers and scientists create instruments of warfare which gave our troops overwhelming military and strategic advantages. Their tremendous accomplishments in carrying on the research, design, and production of such equipment as radar, the proximity fuse, the atomic bomb, and submarine detection, as well as developing superiority in airplanes, tanks, guns, and ships hastened the conclusion of the war and saved untold thousands of American lives.

"Creative ability is one of America's greatest assets—one which we cannot afford to waste. Engineers, already in short supply, must make their contribution to the nation's welfare at their highest capacities where their special training can continue to accomplish miracles of production—our principal weapon in defending our society of free men."

Two Interesting Meetings Held on West Coast

Two meetings have recently been sponsored by the Northern California and Southern California District Councils in connection with the visit of President H. L. Maxwell to the West Coast. The one under the auspices of the Northern California District Council was held as a joint meeting with the San Francisco Chapters of the American Chemical Society and American Institute of Chemical Engineers on March 9 at the University of California. The meeting, preceded by a dinner held at the Faculty Club, was attended by close to 150. Many of those present were members of all three organizations and had a common interest in materials used in the chemical engineering industry. The meeting sponsored by the Southern California District Council was a dinner meeting at the Rodger Young Auditorium in Los Angeles on March 12 and was attended by over 100 members and guests.

At both of these meetings President Maxwell spoke of his experiences in the use of materials in the chemical manufacturing industry. Frequently, the success of a process was contingent upon the proper selection of materials of construction for use in its processing equipment. When a new material which had been developed in a laboratory had reached the manufacturing stage it would only have applicability if it could be made to meet specific needs at a price that would make it attractive and this was contingent upon cost of operation.

President Maxwell cited a number of instances where the cost of maintenance could be considerably reduced by substituting relatively expensive materials for those previously employed. The use of these expensive materials cut down cost tremendously and more particularly eliminated shut-down time which is always a very expensive item. Mention was also made of the economies effected through standardization, with particular reference to the work of ASTM Committees.

In each of his addresses, and particularly the one at Berkeley, President Maxwell emphasized matters of importance to the younger engineer in his approach to industry problems, and mentioned a number of items that should be kept in mind as a guide in his attitude toward his work. President Maxwell's talk was enthusiastically received at both the meetings.

The President was accompanied by the Associate Executive Secretary R. E. Hess, who at each of the meetings spoke briefly concerning some of the activities of the new ASTM committees, and in particular referred to the manner in which the Society's committees cooperate with the committees of many of the other organizations.

The officers of the Northern California District are P. V. Garin, *Chairman*, Southern Pacific Co.; H. P. Hoopes, *Vice-Chairman*, Pabco Products, Inc.; P. E. McCoy, *Secretary*, American Bitumuls and Asphalt Co., and the Southern California District officers are: E. O. Bergman, *Chairman*,

C. F. Braun and Co.; J. B. Morey, *Vice-Chairman*, The International Nickel Co., Inc.; M. B. Niesley, *Secretary*, California Testing Labs., Inc.

President's Night, Philadelphia District

MEMBERS and friends of ASTM, American Institute of Chemical Engineers, and American Chemical Society took the opportunity on February 13 of meeting and hearing ASTM President Harold L. Maxwell as guests of the Philadelphia District.

Preceding Dr. Maxwell's talk was a private tour of the Franklin Institute, the most interesting aspect of which was the Bell Telephone exhibit explaining the principles of microwave transmission.

The ASTM President who spoke on "Chemical Developments and Engineering Materials," and who in his position as Supervisor of Mechanical Engineering Consultants with du Pont has helped many technically trained young men into progressive and forward-looking engineering careers, discussed the process of adaption of the fruits of research into modern chemical plants. This is a field in which material standards and, in particular, standard testing



Present at a luncheon meeting of the Northern California District Council in honor of ASTM President Harold L. Maxwell and Associate Executive Secretary, Raymond E. Hess were, standing, left to right: F. N. Hveem, L. Mittelman, H. de Bussieres, F. M. Harris, F. S. Cook, L. A. O'Leary, D. Finley, D. W. Hadsell, W. B. Kennedy, W. N. Lindblad, W. W. Moore, H. J. Degenholt, J. H. Dunn. Seated, left to right: G. H. Raitt, R. A. Kinzie, Bailey Tremper, P. T. Dresser, Jr., H. P. Hoopes, H. L. Maxwell, District Chairman P. V. Garin, R. E. Hess, District Secretary, P. E. McCoy, R. N. Conner, M. C. Poulsen.

methods have made a significant contribution. Standards have helped make possible the plant scale production of such man-made miracles as nylon, "Orlon," and Dacron, and have served as a dependable guide in continuing the advance of the chemical industry and thereby assuring many of the comforts and conveniences of modern living. Dr. Maxwell's presentation was accented by his reference to samples of the "miracle" materials which were on display prior to, during, and subsequent to his talk.

Metal Finishing's Fifty Years

CONGRATULATIONS are in order for *Metal Finishing* on its Fiftieth Anniversary.

Mrs. L. H. Langdon, publisher of *Metal Finishing*, aptly sums up the growth of this publication in the foreword to a special commemorative golden anniversary issue published in January of this year. Quoting from Mrs. Langdon:

"Since 1903 we have seen the evolution of electroplating and its related industries from an infant barely knowing one solution from another to the highly technical Goliath of today. *Metal Finishing* was founded as *Metal Industry* in January, 1903, as a journal devoted to the non-ferrous metals and plating. At that time there was a sharp distinction between the

iron and steel industry and the light metals. With the passing of time a number of publications were merged and *Metal Industry* became more and more concentrated in the finishing industry—coatings on all metals, ferrous and non-ferrous. In 1939 we purchased the rights, title and mailing list of *Metal Cleaning and Finishing* which enabled us to change our name in 1940."

To commemorate its golden anniversary, *Metal Finishing* assembled a collection of articles in its January, 1953, issue, each of which spans the 50 years in a different way. Many of these contributors will be recognized as men active in ASTM. These authors included George B. Hogaboom who wrote on "The Plater of 1903"; Frederick A. Lowenheim, who has done more historical research in the finishing field than any other author contributed "50 Years of Electroplating." William Blum, the first man to bring standards of control to this industry, wrote, "Fifty Years Progress in the Testing and Specification of Electroplated Coatings." Royal Clarke contributed a page on the early formative meetings of the American Electroplaters Society. Thomas A. Trumbour, associated with metal finishing since the *Aluminum World* days, going back even before 1903, summarized the story of journals in the finishing industry.

Space prohibits abstracting all of these worth-while papers, but we feel that the

attention of our membership should be directed to the paper by Dr. Blum who begins by point out that in any field of applied science, three pertinent questions may properly be asked: (1) How are you doing it? (2) Why are you doing it that way? and (3) How well are you doing it? He expects the next few decades to yield greater progress in our understanding of electrolysis than has been accomplished in the last 50 years. In contrast, the methods of measuring and testing the properties of electrodeposits have shown progress in the last century. The thickness, porosity, protective value, adhesion, and luster of the coating form the basis of many specifications and hence must be susceptible to tests.

One obstacle to the development of accelerated tests is the uncertainty that still exists regarding the exact behavior of plated coatings and surfaces and the factors that influence that behavior. The extensive exposure tests conducted since 1932 by the National Bureau of Standards, American Electroplaters Society, and ASTM have yielded valuable information that is largely the basis for existing ASTM specifications. The cooperation of the AES with the ASTM in the preparation of specifications has resulted in wide application. The net result is a great improvement in the quality and acceptability of plated coatings.



The Society's Directors and Staff Officers at the January Board Meeting at ASTM Headquarters. Standing, left to right: W. H. Lutz; R. A. Schatzel; A. O. Schaefer; F. P. Zimmerli; H. K. Nason; J. R. Trimble; M. A. Swayze; E. O. Slater; J. W. Bolton; D. K. Crampton; G. R. Gohn. Seated, left to right: B. A. Anderton; R. H. Brown; R. E. Hess, Associate Executive Secretary; R. J. Painter, Executive Secretary; Miss Ounan, Executive Assistant; H. L. Maxwell, President; T. S. Fuller, Past President; L. J. Markwardt, Past President; J. G. Morrow, Past President; N. L. Mochel, Vice President; L. C. Beard, Vice President. Not Shown in the Photograph are Board Members Stanton Walker and H. G. Miller.

Committee Week

(Continued from p. 17)

This final and rather extensive report contains results obtained in a round-robin testing program on stiffness at low temperatures of crude rubber, GR-S, and polyethylene stocks. The tests were made by 11 cooperating laboratories and included 9 recognized methods of performing stiffness tests. Test temperature ranged from -80 to $+73.4$ F. The wealth of data obtained from the studies is of considerable importance in view of the work being done by the Army, Navy, and Air Forces on use of materials under extremely low-temperature conditions. This investigation is only one of several contemplated by this committee. It is planned to carry on similar studies of brittleness and hardness of elastomeric materials.

At the meeting results were reported of a round-robin investigation made by eight cooperating laboratories on hardness of crude rubber, GR-S, vinyl, and polyethylene stocks, at temperatures ranging from room temperature down to -80 F. These results will be correlated by Ross Shearer, B. F. Goodrich Co., in a further report to be presented in June. An interesting report of work being done by the Bureau of Ships was given by J. R. Britt. It was reported that the Tentative Method of Test for Brittle Temperature of Plastics and Elastomers (D 746) has now been included in Government Specification MIL-R-3065.

The three ASTM committees primarily concerned with spectroscopy held meetings at the William Penn Hotel, Pittsburgh, Pa., during the week of March 2. These meetings were in conjunction with the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy.

E-2 on Emission Spectroscopy

Meetings of Committee E-2 on Emission Spectroscopy and its subcommittees were held March 5 and 6. Final arrangements were made to complete

work on the forthcoming compilation of "Methods for Emission Spectrochemical Analysis." The last of some 50 suggested methods and suggested practices were released for publication, and it is planned to have the compilation available for distribution within the next few months.

Preparations were also completed for a Symposium on Fluorescent X-Ray Spectroscopy to be sponsored at the 1953 ASTM Annual Meeting in June.

The committee reported that work on the development of tentative methods for emission spectrochemical analysis had progressed to the point where methods for analysis of aluminum lead and zinc should be ready for submittal to ASTM for publication as tentative during 1953. A proposed revised tentative method for spectrochemical analysis of zinc-base alloys and zinc by the D-C Arc 1-1 Solution Technique, to replace the current ASTM Methods E 26 and E 27 for analysis of zinc and zinc-base alloys, has been completed by the committee for inclusion in the compilation of suggested methods, subject to approval by ASTM.

E-13 on Absorption Spectroscopy

Meetings of Committee E-13 and its subcommittees were held on March 3, 4, and 5.

The most significant committee activity reported concerned the manner of coding of infrared data and the publication of an IBM card index of such data. The committee is sponsoring the development of a uniform coding system based essentially on the one developed by L. E. Kuentzel of the Wyandotte Chemicals Corp. The committee has further recommended that ASTM consider publication and distribution of an IBM card index of infrared data based on the index currently being produced by Wyandotte.

Development of a uniform coding system for ultraviolet data was also considered and will be studied by the committee. It is contemplated that, eventually, the coding systems will be

combined to cover absorption spectroscopy as a complete field, with subkeying so that infrared or ultraviolet spectra can be separated as a group by IBM sorting.

The committee has also initiated work on development of uniform nomenclature in absorption spectroscopy and on methods of measuring significant limiting characteristics of apparatus.

E-14 on Mass Spectrometry

The first meetings of the new ASTM Committee E-14 on Mass Spectrometry since its organization were held on March 2 to 6. The meetings featured four half-day sessions of papers on mass spectrometry, presented under the joint sponsorship of Committee E-14 and the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy.

Titles, scopes, and programs of work were approved for five subcommittees of Committee E-14, as follows: Program and Papers, Theoretical and Fundamental Aspects, High Molecular Weight and Solids Techniques, Methods and Data, and New Instruments and Techniques.

E-4 on Metallography

While it does not appear that Committee E-4 will recommend any new documents or revise any of its existing standards on metallographic techniques during 1953, several other developments of technical interest should be noted.

A symposium on Electron Microscope Techniques will be held during the 1953 Annual Meeting of the Society in Atlantic City. In addition Subcommittee XI on Electron Microstructure of Steel will publish its third progress report. The work of this subcommittee has been widely acclaimed and its first two progress reports published in 1950 and 1952 were enthusiastically received.

The committee is already planning the metallographic section of the photographic exhibit to be held in conjunction with the 1954 Annual Meeting of the Society. In addition to the industrial metallographic exhibit, the various schools and universities in the United States may be interested in an undergraduate contest in metallographic technique. Participants will have their choice of prepared specimens of an aluminum alloy or a steel. All specimens will be identical and the students exhibiting the best metallographic techniques will be awarded cash prizes. Another portion of the exhibit will consist of examples of metallographic work solicited from European industries and universities, in which it is hoped a spec-

"The day is past when rule by a group of citizens trained in any one field can give satisfactory service to a nation in a complex world. The engineer's voice must be heard, and his presence felt, in the deliberations of national councils, for he has something unique to contribute to the understanding of present-day problems; and I would like to testify from my experience that an engineer can get elected, and is welcomed by his fellow legislators and administrators. Following many years of reasonably successful professional practice, I now find there is a special kind of satisfaction in public service which makes all the inevitable sacrifices seem unimportant."

—Clarence D. Howe, Canadian engineer and statesman, upon acceptance of 14th Hoover Medal.

ial exhibit from a well-known European metallographer will be included.

E-5 on Fire Tests of Materials and Construction

The inclusion of a hose stream test requirement for materials having fire ratings under one hour in the standard fire test methods E 119, and a proposed small-scale fire test method highlighted the discussions at the meeting of Committee E-5 on Fire Tests. After two full days of subcommittee meetings and considerable discussion at the main meeting, action was taken to submit to letter ballot of the committee a change in E 119, which would add in Table I an additional resistance period of $\frac{1}{2}$ hr and over, if less than 1 hr, with water pressure at 30 psi for a duration of 1 hr. Corresponding editorial changes in other parts of the standard were also approved. The proposal to add a small-scale fire test method to E 119 as an appendix was not approved by the committee and the draft was returned to the special task group for further review of negative vote comments received. It is expected that a new draft will be prepared and presented to the committee for early action, possibly at the next meeting tentatively planned to be held during the 1953 Annual Meeting. The new draft will be circulated to the entire committee previous to this meeting.

The revision to the standard fire test methods E 119, referring to Section 10 on conditioning of specimens, which was not approved at the 1952 Annual Meeting, was accepted with certain changes made as suggested. The recommendation will now be resubmitted in the 1953 Annual Report.

Encouraging progress was reported on a proposed test procedure, which will establish performance standards for

use in defining noncombustible, or incombustible, materials. A proposed method is expected at the next meeting; its scope will limit the procedure to specimens which are homogeneous in character, of a specified size, and of one material or intimate combinations of materials.

E-7 on Non-Destructive Testing

Committee E-7 is still working on several projects mentioned in the 1952 report of the committee. These projects include reference radiographs for welds, calibration blocks for ultrasonic testing, color code for searching units, reflection and resonance methods for ultrasonic testing, methods of magnetic particle testing, and minimum requirements for the various features of radiographic technique. The reference radiographs for welds will be printed with the keysort type of coded cards for ready sorting.

In addition it is expected that the Society will print during 1953 reference radiographs for aluminum and magnesium castings. These have been made available to the Society through the courtesy of the Bureau of Aeronautics of the Navy Department.

A technical session on the "Correlation of Non-Destructive Test Results" will be held during the 1953 Annual Meeting of the Society.

E-9 on Fatigue

The first two efforts in recent years to publish abstracts of articles on fatigue having proved successful, Committee E-9 on Fatigue at its meeting agreed to collate and publish abstracts of fatigue articles which appeared in the literature during 1952. This will be made available later this year as *STP*

No. 9D. It is planned tentatively to combine periodically these annual groups of references.

Subcommittee IV on Large Machines and Test Correlation, in order to give more widespread publicity to an extensive program necessitating financial support, plans to append to the 1953 Annual Report of the committee a résumé of the proposed test program designed to further the knowledge of "size effect" in fatigue testing.

A recently formed group on statistics is making progress on the development of recommended practices for conducting fatigue tests according to accepted statistical methods. Five methods are under consideration: (1) standard run-out, (2) staircase, (3) probit, (4) step, and (5) prot. When these methods are sufficiently complete they will be incorporated in the ASTM Manual on Fatigue Testing, *STP No. 91*, which the committee is planning to revise in the next year or two. It is planned that these methods before reaching that point would be published in the ASTM BULLETIN for comment.

E-10 on Radioactive Isotopes

In order to acquaint ASTM members with the use of radioactive isotopes in industry, a symposium sponsored by Committee E-10 will be conducted at the ASTM Annual Meeting in June. Papers will cover the following subjects:

1. Properties and Uses of Radioactive Isotopes,
2. Possible Applications in ASTM Work,
3. Laboratory Design, Health, Safety, and Personnel Training,
4. Instrumentation,
5. Management's View of Radioactivity, and
6. AEC Film on Methodology.

To ASTM Members: Your help is needed in maintaining that constant increase in ASTM Membership

To the ASTM Committee on Membership,
1916 Race St., Philadelphia, 3, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below:

This company or individual is interested in the following subjects: indicate field of activity, that is, petroleum, steels, non-ferrous, etc.

Date _____

Signed _____

Address _____

In addition an exhibit of representative instruments and equipment is being planned for continuous showing throughout the day in a room adjacent to the symposium room. A demonstration period will be held in the symposium room consisting of the instruments on exhibit and various other special equipment. The symposium will be closed by a panel discussion of the speakers and other selected ASTM committee members.

Since the present plan is not to publish the proceedings of this symposium, all interested parties are urged to be present during its presentation.

E-12 on Appearance

Committee E-12 sponsored a Symposium on Gloss which was the main feature of the ASTM Spring Meeting on March 4 and is reported on page 8.

Subcommittee I on Definitions reported progress in cooperation with Subcommittee X on Optical Properties, of Committee D-1 on Paint, Varnish, Lacquer, and Related Products, especially on the definition of three important terms. The three terms for which proposed definitions will be submitted for comment are: gloss, luminous fractional reflectance, and specular gloss.

Subcommittee II on Color reported that because of the great interest shown in the Symposium on Color Difference Specification, held in March, 1952, in Cleveland, Ohio, the Symposium, together with the discussion, had been printed. This earlier Symposium, which also had been sponsored by Committee E-12, comprises eight papers. Copies of the Symposium may be obtained from ASTM Headquarters.

The final draft copy of a proposed Method of Test for Reflectance of Opaque Surfaces has been prepared by

Committee E-12 in cooperation with Committee D-1 and Committee C-22 on Porcelain Enamel. After approval by letter ballot, it is planned to submit this method to the Society for publication as tentative, subject to the concurrence of the other two cooperating committees.

Subcommittee III on Gloss was apprised of seven specular gloss methods published by ASTM and other organizations. Interest continues toward the consolidation of as many of these methods as possible.

NBS Completes 13-Year Corrosion Tests of Galvanized Steel in Soils

Results of a National Bureau of Standards study of underground corrosion of hot-dipped galvanized steel pipe has confirmed previous NBS work in showing that galvanized steel having 3 oz of zinc per sq ft of exposed surface is highly resistant to corrosion in many soils which are very corrosive to bare steel.

Short lengths of both galvanized and uncoated steel pipe, and also plates of zinc, were buried at 15 widely separated test sites for periods up to 13 yr. After each of five periods of exposure, a set of specimens of each material was removed and returned to the NBS laboratories. After removal of the corrosion products, determinations were made of loss in weight, depth of the deepest pits, and the percentage of area of the galvanized specimens on which coating remained.

The zinc coatings provided good protection in most of the soils. In one soil in which bare steel pipe was perforated by corrosion after exposure for only a

few years, the coating on the galvanized specimens remained perfectly continuous throughout the entire 13-yr period. In only two of the 15 soils, both organic, was the zinc coating of negligible protective value.

An interesting finding of the NBS study was the high corrosion resistance that the galvanized specimens continued to show in most of the soils after the outer zinc coating, and even after the zinc-iron alloy layer, had entirely corroded away. This continuing protection is tentatively attributed to an inorganic coating, probably siliceous, believed to have been deposited by galvanic action between the outer zinc coating and the underlying steel or alloy layer.

Analysis of the data shows that the minimum weight of zinc coating required to protect steel for a minimum of 10 yr depends on the nature of the soil environment. A 2-oz coating gave sufficient protection in inorganic oxidizing soils, but for inorganic moderately reducing soils a 3-oz coating was required. Highly reducing soils, both organic and inorganic, require coatings heavier than 3 oz per sq ft.

In order to obtain maximum life from galvanized pipe in practice, it is necessary either to construct the entire piping system of galvanized pipe or else to electrically insulate the galvanized sections from pipe of other metals. Otherwise, the zinc coating will be removed by galvanic action.

ASTM Annual Meeting

Atlantic City

June 29 — July 3

To ASTM Nonmembers: The Society welcomes inquiries on the "Advantages of Membership"

To the ASTM Committee on Membership
1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on Membership in ASTM and include a membership application blank.

Signed _____

Address _____

Date _____

April 1953

ASTM BULLETIN

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Color in Business, Science, and Industry

ALTHOUGH an attempt is made to reach each segment of the large and varied audience indicated in the title, this reviewer comes away with the impression that most of this manuscript was prepared before the title and its broad scope were selected. The author, Deane B. Judd, probably had much assistance from the publisher in the selection of the title. An authoritative book on color for Business and Industry would still make a welcome addition to the literature. The present volume is concerned primarily with the science of color.

Dr. Judd discusses several problems in a scientifically rigorous manner, but somewhat unintelligible to the average citizen in Business and Industry. The following passage on p. 96 is an example: "These tristimulus values may be expressed for any known light source and for any known observer with respect to any of a triple infinity of primary colors, each set of primaries yielding a separate colorimetric coordinate system." This was clearly not intended for the man in Business or Industry.

Occasionally the exposition is not as lucid as Dr. Judd amply demonstrates he can be. Witness, this passage on page 120: "A visual colorimeter is a device whereby the unknown light fills one part of the field of view and another near-by part, the comparison field, may be filled with one known color after another." However, Dr. Judd then proceeds to give an excellent practical explanation of visual colorimeters and their limitations.

The discussion of color tolerances includes a concept which is of itself ample reward to the man in Business and Industry who can manage to read as far as p. 270. The author states: "A color tolerance, like other tolerances in a purchase order, represents a compromise between what the purchaser really would like to get and what the manufacturer can supply at a reasonable price."

In spite of the fact that much of what has been said about the book is derogatory, in regard to Business and Industry—this is an excellent book for those primarily interested in the science of color. Dr. Judd has written excellent and extensive discussions of color vision, color systems, and the fundamentals of colorimetry. These sections will long remain authoritative references in the technical literature of color. No

serious student can afford to be without a copy.

The book is divided into three parts:

- I. Basic Facts
- II. Tools and Technics
- III. Physics and Psychophysics of Colorant Layers

Included are discussions of color vision, spectrophotometry, colorimetry, color scales and systems, color reproduction, gloss, opacity, and identification and formulation of colorants.

The book, published by John Wiley and Sons, N. Y., has 367 pages of text and tables and a bibliography with 351 entries.

DANIEL SMITH

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Die Bruchgefahr Fester Korper bei ruhender-statischer-Beanspruchung

Eidgenossische Materialprufungs- und Versuchsanstalt Fur Industrie, Bauwesen und Gewerbe, Zurich, September, 1949 (118 pages of text, 389 photographs and figures, 12 tables; also contains a translation in English of the Summary and Conclusion).

A comprehensive series of tests was conducted on eight metals (rolled steel, cast steel, aluminum, copper, zinc, aluminum bronze, tombak, and cast iron) and four nonmetallic materials (marble, cement, cement mortar, and porcelain). Tests were conducted using cylinders with solid and hollow cylinder sections, with and without the application of internal or external pressure, to study the state of stresses in the uniaxial, biaxial, and triaxial conditions. These test results are compared with the various classical theories of failure and with a new theory developed by the authors, M. Ros and A. Eichinger. It is concluded that each material must have its own method of rupture, but it appears that, in general, the Mohr's theory can be taken to give the most appropriate mean values though the correlation is not considered very good.

S. A. GORDON

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Plastics

"PLASTICS" is the subject of Volume I of the Selected British Government Research Reports series issued by the Ministry of Supply.

Twenty-one reports are included in this publication, each containing ab-

stracts, individual tables of contents, and lists of illustrations. In addition to experimental details and discussions of results, each report contains its own bibliography.

Among the subjects covered in these reports are mechanical properties of high polymers; plasticizer-polymer interaction; sorption of water by high polymers; setting process of phenol-formaldehyde resins; effects of humidity; reinforced plastic material in aircraft construction; correction of indicated impact value of brittle plastics; directional strength and stiffness of fibrous materials; microscopic examination of reinforced synthetic resins; "Perspex"; and synthetic resin glues.

This volume is published by Her Majesty's Stationery Office and copies can be obtained in the United States from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y., for \$8.

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Handbook of Cast Iron Pipe Research

THE second edition of the Cast Iron Pipe Research Assn.'s "Handbook of Cast Iron Pipe" is an expanded and revised version of the widely distributed 1927 volume.

New sections have been added to the new Handbook and others rewritten in order to bring it up to date with respect to the important changes that have occurred in the industry in the last 25 years; advances such as those in specifications; increased knowledge of stresses in underground piping; foundry practice and control; development of new joints; and improvement in pipe laying practice.

Among the new sections are those dealing with new processes of manufacture; specifications for centrifugally cast pipe; submarine joints; short-bodied fittings; and mechanical joint pipe. The section dealing with carrying capacity has been entirely changed to include a number of flow tests on cement-lined pipe.

Intended to give complete information on cast iron pipe in service under ground, under water, or above ground, this publication is designed in good reference style, well indexed, easily read, with flexible leather covers.

Copies can be obtained from the Cast Iron Pipe Research Assn., Chicago 3, Ill., for \$5.

Nuclear Radiation—Its Detection and Measurement

By Ernest H. Wakefield¹

THE author has been asked to present a brief paper on nuclear radiation, its detection and measurement, to form a background for other papers to be sponsored by ASTM Committee E-10 on Radioactive Isotopes. This present paper is not meant to be exhaustive. Papers treating in greater detail the separate items herein discussed have appeared in the scientific journals. The various radiations, the sensing and recording elements for these radiations, will be treated in that order.

There are six different types of commonly used nuclear radiations; alpha particles, beta particles, positrons, gamma rays, protons, and neutrons. Each of these radiations is detected directly or indirectly by the ionization which it causes on passage through a medium, such as a gas.

An alpha particle is a fast moving helium nucleus. This radiation is given off by several elements, among them plutonium, one of the components of the atomic bomb. Alpha radiation has typically a path length in air of from 2 to 5 cm; hence it can be stopped by even a sheet of paper. Alpha particles are emitted in a monochromatic or line spectrum and are characterized by a unique range. In contrast, beta radiation, which is the name given to fast moving electrons emitted from radioactive isotopes, is emitted in a continuous spectrum of energies up to a maximum value. Beta particles have a typical path length in air from a few millimeters to perhaps a few tens of meters. Cosmic ray electrons, however, may have path lengths in air much greater. Beta particles generally can be shielded against by a thin layer of metal compared to correspondingly energetic gamma rays which are discussed below.

Positrons, which are positive electrons, may have an extremely short life combining readily with free negative electrons, with which they are identical

in regard to path length for a given energy.

Gamma radiation, which is given off by a host of isotopes and which is considered less particulate than the two previously named radiations, is absorbed exponentially, and hence there is no absorber thickness which reduces the intensity truly to zero. Therefore, shielding against gamma radiation is difficult.

Protons, which have a path length of several meters in air, can be readily stopped, resembling alpha particles very closely in this respect.

Neutrons are unlike the previously named radiations in that they are non-ionizing in nature, but when they enter a nucleus often convert it to a radioactive isotope whose emission is detectable (for instance when they enter the nucleus of the boron 10 isotope, the nucleus disrupts, emitting an alpha particle and a lithium particle; the alpha and lithium particles can be detected). So neutrons are detected by secondary means. They are easily absorbed by thin layers of certain elements such as boron and cadmium, each of which has a large capture cross-section for neutrons, when the neutrons are of low energies. Neutrons are extremely penetrating when their energy

is large. Effective stopping of them is therefore achieved by first reducing their energy with a "moderator" such as paraffin or water. Fast neutrons may also be indirectly detected by observing the ionization resulting from the recoil-proton emitted by a neutron irradiated hydrogenous material, such as a plastic, or an anthracene crystal.

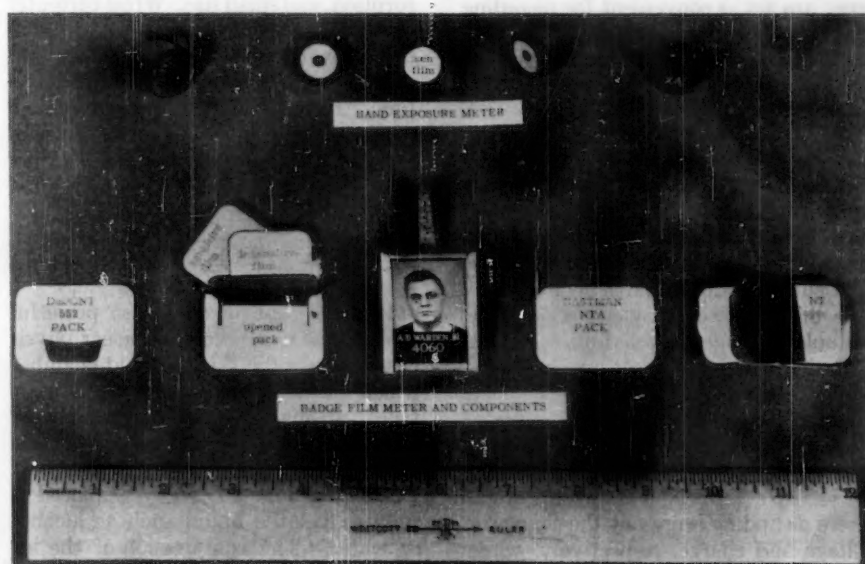
SENSING ELEMENTS

Eight different instruments are used for the measurements of these nuclear radiations. It will be strategic for us to discuss first the sensing elements of these instruments and then their recording elements, keeping in mind the principles underlying each type.

A natural listing of instruments for the detection of radioactivity would include photographic film, conduction detectors, chemical integrating indicators, cloud chambers, ion chambers, proportional counters, Geiger-Mueller counters, and scintillation counters. Each of these instruments is, in truth, a sensing element for ionizing radiation, but associated circuits may be required to record the *intensity* of the radiation that the sensing element detects.

Photographic Film:

Photographic film is the instrument



Courtesy Oak Ridge National Laboratory

Fig. 1.—Film Meter of the Badge and Ring Type and Film Packets.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

¹ President of Radiation Counter Laboratories, Inc., Skokie, Ill.; Chairman of the Subcommittee on Nuclear Laboratory Instruments, Hardware, Recording and Accessory Equipment of the Institute of Radio Engineers.

with which Becquerel first discovered radioactivity in 1896. Today it is one of the most widely used sensing elements for radiation. It is familiar to all scientists in its use in X-ray technique. Here the blackening of the film is related to the quality and quantity of the radiation. Personnel monitoring film badges are widely used in radioisotope laboratories. Each film generally contains a sensitive and insensitive film for low- and high-range beta and gamma ray monitoring encountered in areas. Where neutrons are prevalent, a particle emulsion film for fast and thermal neutron monitoring is used. Figure 1 shows a film meter of the badge and ring type and film packets, which are rather typical of those commonly used for personnel monitoring.

While the opacity of the film resulting from radiation is used in personnel monitoring, recent developments—particularly with thick films in conjunction with detailed microscopic studies of the track resulting from incoming radiation—have rendered an important new tool for the physicist. By close study of the track, whether straight or irregular, the number of developed grains per unit length, the study of "stars" or many pronged traces (and relative angles of these traces) yields to the experienced student much information not heretofore known. Films are also available which are more sensitive to one type of radiation than another so that sensitivity and selectivity have been increased. Such films are used in cosmic ray studies and in the vicinity of nuclear accelerators. Two additional advantages of photographic film are its nearly permanent record of nuclear events and its resolution of the radioactive surface. Films however, are not as convenient for recording individual nuclear events at high repetitiveness as are ion chambers, counters, or photomultiplier tubes.

Conduction Detectors:

Experimentally and uncommonly, crystals, liquids, and certain solids have been used to detect radiation. In the first case, a certain crystal with a particular lattice arrangement serves as a dielectric across which is placed a suitable voltage. Radiation, piercing this dielectric, frees certain electrons which, because of the electric field, migrate toward the positive plate. This movement of charge is detected as a voltage pulse from the relationship $dv = dq/c$ and dv is suitably recorded where dv and dq represent the change in voltage and charge, respectively, while c represents the capacitance of the detector. The advantages of such a system are two. The high density

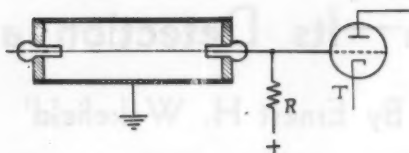


Fig. 2.—Ion Chamber.

Physically, an ion chamber, a proportional counter, and a Geiger-Mueller counter may each be considered as a conducting cylinder which has coaxial with it a conducting wire known as an anode. If the instrument is used as a proportional or as a Geiger-Mueller counter, a condenser is placed between R and tube T .

of the dielectric yields increased sensitivity to gamma radiation. The pulse duration is exceedingly short. The disadvantages may be summed up briefly as follows: the difficulty of choosing suitable crystals; the fact that, as the crystal counter continues to absorb radiation, it polarizes and thus gradually reduces the magnitude of the voltage pulse. However, this detector, while still in the experimental stages of development, does offer promise.

Chemical Integrating Indicators:

Chemical indicators are solids or liquids which change color when subjected to radiation. The amount of color change is a measure of the quantity of radiation absorbed. Alkali halides such as LiF, KBr, and NaCl have been used for chemical integrating indicators for both high energy photons and nuclear particles. Radiation dosage measurements have been based on the number of color centers formed in single crystals under X-ray and cathode-ray irradiation. The crystals have as advantage wide range of irradiation, high absorption, and small size. While currently useful for extremely high levels of radiation flux chemical indicators are not nearly so widely used as the other detectors. They are neither sensitive enough nor sufficiently quantitative to be useful in most laboratory experiments. Their use appears at this writing to be limited to military service.

Cloud Chambers:

Probably one of the most powerful tools of the experimental nuclear physicist has been the Wilson cloud chamber which has been used for studies of particles arising from cosmic radiation, high energy accelerators, or nuclear reactors. This apparatus consists of a variable volume in which is placed a suitable volatile liquid such as alcohol or water. The compression of the internal atmosphere and then the sudden reduction of pressure above the liquid induce a super saturation of this in-

ternal atmosphere. Radiation traversing this atmosphere leaves a path of ions which serve as nuclei on which the vapor condenses to form visible droplets. Thus, a visual record is made of the ionizing event. This record may be photographed and preserved. For the purpose for which the Wilson cloud chamber was devised, there seem few disadvantages. Among its advantages when it is used with suitable equipment may be listed: discrimination between radiations of various types and energies, and the recording of rare nuclear events.

Ion Chambers:

An ion chamber is a volume of gas in which a field is created by a system of charged electrodes. Ions produced in this gas by an ionizing event are collected at these electrodes. The ion current is a measure of the character and intensity of the radiations. The gas amplification within the counter tube is unity; hence the signal from the ion chamber requires considerable amplification before it can be recorded. The anode is generally from $\frac{1}{16}$ to $\frac{1}{100}$ the diameter of the cathode and is coaxial with it. Figure 2 illustrates the principle of an ion chamber. A typical voltage across these electrodes would be 100 v. Ion chambers are widely used as instruments in health work, inasmuch as they establish to the highest degree a linear relationship between the ionization formed by the radiation and the energy of the radiation. It may readily be seen that this aspect of ion chambers is important because the damage to body tissue by radiation is, to a first approximation, proportional to the number of ions formed in the tissue cell. Put in another way, the damage to body tissue is proportional to the amount of energy given up by the radiation per length of path.

A widely used type of ion chamber is of the personnel monitoring type. This instrument, called a pocket meter, commonly the size of a fountain pen—and so carried—is essentially a cylindrical condenser of high leakage resistance. The pocket meter is charged with a potential of from 10 to 200 v. Exposure to penetrating radiation reduces this charge, and the amount reduced is correlated to the roentgen field of radiation. This principle of discharging of a condenser by radiation is also applicable to electrometers. An ionization chamber may have connected to it, as an aid in reading the radiation intensity, a direct-coupled amplifier. The disadvantages of an ion chamber may be associated with the difficulties in maintaining the extremely high resistance

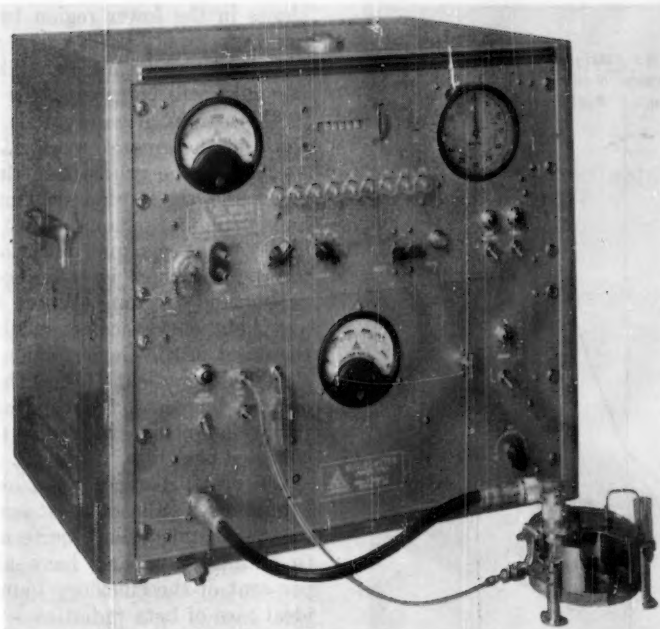


Fig. 3.—Laboratory Type of Proportional Counter.

Before the electronic circuit containing the power supply, scaling circuit, and recorder is the sensing element here used as a proportional counter.

(10^{12} ohms) of a component associated with d-c amplifiers.

An unsaturated type ion chamber has been developed in which the electric field between the electrodes is established by the difference in contact-potential between the dissimilar metals which form these electrodes.

Proportional Counters:

A proportional counter is a system of electrodes in a gas in which the number of ions produced in the gas creates a pulse which is proportional to the number of ions produced in the gas by the primary ionizing particle. The gas amplification within the counter tube is greater than 1 and probably less than 10^6 . The electronic amplification necessary for recording the signal is less than in the case of the ion chamber. The proportional counter tube, when in operation, may be likened to a charged condenser. Generally the anode is on the order of $\frac{1}{1000}$ of the diameter and coaxial to the cathode. If a potential of, let us say, 3000 v is placed across the electrode system, an electric field is established. Because of the coaxial geometry, the gradient increases exponentially as the anode is approached. The introduction of an ionizing particle into this gas dielectric sets up a chain of multiple ionizations through the action of the Townsend avalanche. The result of the chain of events is that, at the output of the proportional counter tube, a signal is emitted that may be 1000 times that obtained in the ion chamber discussed

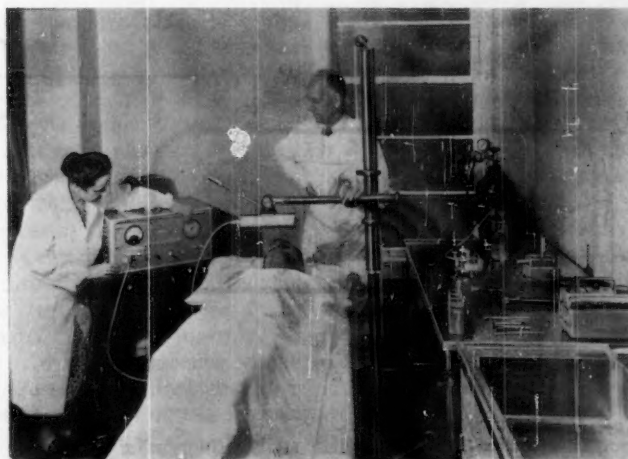
above. This increase in the magnitude of the signal due to gas amplification, it is to be noted, makes less complex the circuitry associated with a proportional counter tube as compared to that associated with an ion chamber. In addition, inasmuch as the signal is proportional to the number of ions formed by the radiation, discrimination between various types of radiation can be achieved by proper circuitry. Moreover, the speed of operation of a proportional counter is frequently limited only by its electronic circuit. Because of these advantages, the pro-

portional counter is widely used today in quantitative laboratory studies. Figure 3 shows a laboratory type of proportional counter.

Geiger-Mueller Counters:

A Geiger-Mueller counter is a system of electrodes, usually consisting of a cylinder and concentric wire in a gas. The center wire is at a positive potential with respect to the cylinder. Under suitable conditions, an ionizing event may produce ions in the gas, and the ions in turn create between the electrodes a uniform voltage pulse independent of the number of ions formed by the initial ionizing event. The signal from a Geiger-Mueller tube is typically 1000 times greater than from a proportional counter, being on the order of a few volts. Consequently, a rather simple recording circuit is required when a Geiger-Mueller counter is used for the sensing element. As a result, this type of counter is in frequent use. It has, however, certain disadvantages. It cannot readily discriminate between different types of radiation, nor can it give a uniform response for various wavelengths. Moreover, its operation is some 100 times slower than a proportional counter. Because of its low initial cost, however, as well as certain other advantages noted above, the Geiger-Mueller counter is today the most widely used sensing unit.

Figure 4 shows a Geiger-Mueller counter and scaler system in use in the treatment of disease. The Geiger-Mueller counter tube is contained in the shield over the patient. A cable connects the counter to the scaler. A



Courtesy of Dr. Linden Seed

Fig. 4.—A Geiger-Mueller Counter Used as a Sensing Element in the Treatment of Hyperthyroidism.

The counter is in the shield above the patient. A cable connects it to a power supply, scaler, and recording circuit.

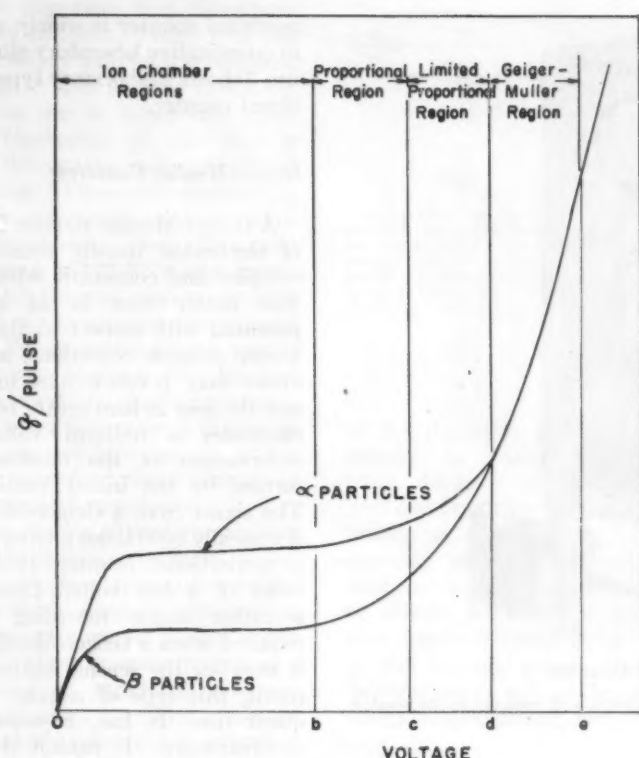


Fig. 5.—Operating Regions of a Sensing Element Used as an Ion Chamber, Proportional Counter, and Geiger-Mueller Counter with All Parameters Remaining Constant Except Applied Voltage.

comparison of an ion chamber, proportional counter, and a Geiger-Mueller counter can probably best be made by referring to Fig. 5. Notice that charge per pulse is plotted *versus* voltage or electrical gradient between the anode and cathode. As the voltage between these two elements is increased above zero, the electrons and positive ions

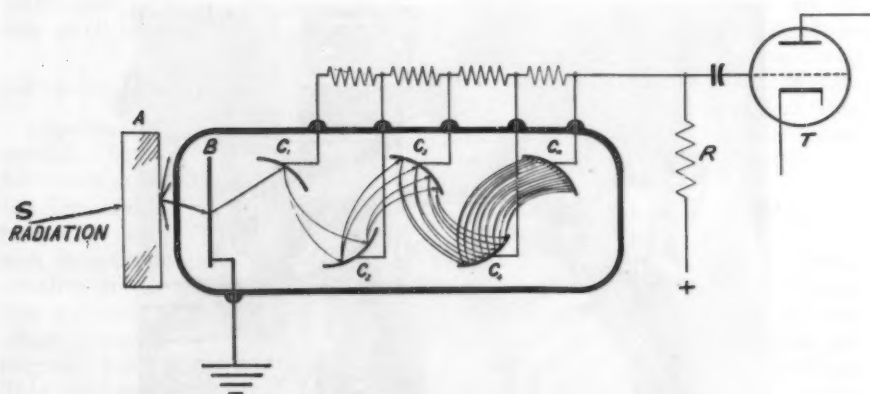
which resulted from the passage of a charged particle through the gas separate and migrate to the anode and cathode, respectively. The charge per pulse in the ion chamber region increases until the effect of "saturation" occurs. That is, all ions from each event are collected. From then on, there is a flat region. A study of Fig. 5

shows in the lower region two curves, one from a beta particle and the upper from an alpha particle. The charge per pulse will be greater, for the latter in this region of gain equals unity because of the greater specific ionization. As long as the gain within the counter gas is one, the sensing element is in the ion chamber region. Just as soon, however, as gas multiplication occurs, the phenomenon is described as the proportional region. Where the alpha and beta curves coincide, this marks the onset of the Geiger region. As the electrical gradient from this region onward increases, the type of ionizing radiation no longer influences the charge collected per pulse.

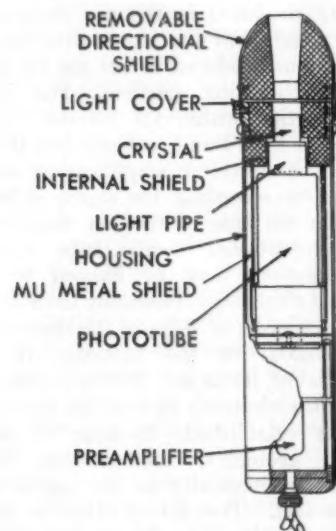
Geiger-Mueller counters, as is characteristic of all gaseous sensing element instruments, are quite insensitive to gamma rays and have about one per cent of the efficiency found for the ideal case of beta radiation.

Scintillation Counters:

A scintillation counter is a transducer composed of either a fluorescing crystal or noncrystalline solid, or fluorescing solution, and a photomultiplier tube. The crystal transposes radiation of short-wavelength into ultraviolet or blue light. These tiny flashes, which are composed of photons, strike a photo-sensitive surface and thus cause electrons to be emitted in a suitable electric field. The electrons, striking a dynode at more positive potential, emit a number of electrons greater than the



(a) Symbolic representation. Source *S* emits radiation which strikes fluorescing crystal *A*, which emits photons. These photons cause electrons to be emitted from photo-cathode surface *B*. These electrons strike succeeding dynodes *C*₁, *C*₂, etc., finally being collected at *C*_n. This charge is amplified by electronic circuit *T* and finally recorded by a scaler (not shown).



(b) Cutaway view illustrating a typical scintillation counter and shield for connecting onto a scaling circuit.

Fig. 6.—Scintillation Counter.

number which has arrived. Striking the next dynode at still higher potential, the electrons increase their number through the principle of secondary emission. With their arrival at the final dynode in the cascade process, a signal of typically $\frac{1}{50}$ of a volt is emitted at the output of the dynode system (called a photomultiplier tube). This signal is amplified and recorded. Figure 6, a symbolic representation of a scintillation counter, shows the dynode system. The advantages of scintillation counters are their extreme speed of operation and their high efficiency in the detection of gamma radiation, to which they are approximately 50 times as sensitive as are Geiger-Mueller and proportional counters. Scintillation counters are also capable of speeds approximately 400 times as great as that of Geiger-Mueller counters. A disadvantage of photomultiplier tubes is their response dependency upon various parameters. A further disadvantage is, in certain cases, their background. But with special improvements the scintillation counter tube may become one of the most important instruments for detecting radiation.

RECORDING ELEMENTS

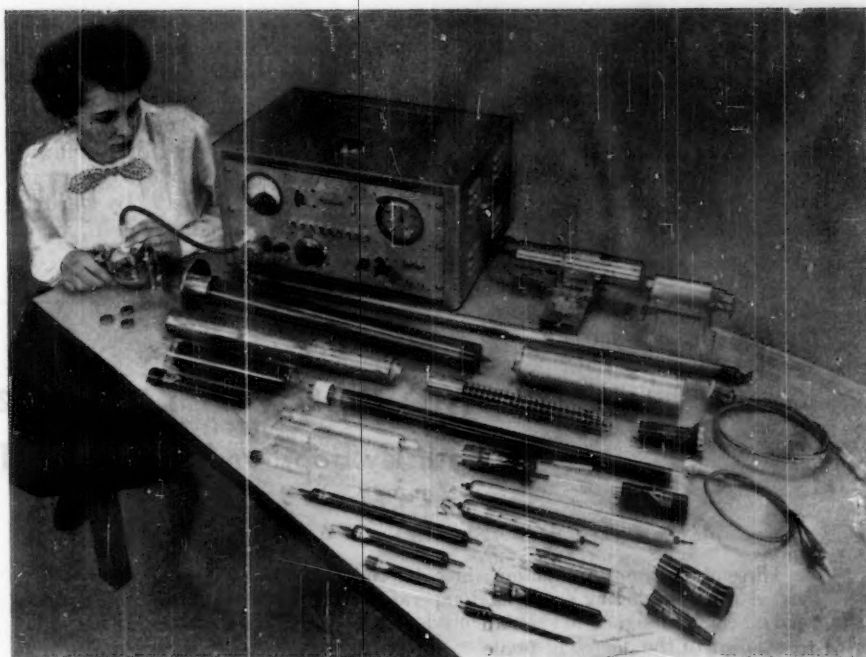
There have been described above eight types of sensing elements. It is the nature of every sensing element that some sort of reading device, called a recording element, must be associated with it. Typically, this is electronic in nature, providing both amplification of the signals and an electroactuation of a mechanical register.

Recording Element for Photographic Film, Chemical Integrating Indicators, and Cloud Chambers:

Photographic film which has been exposed to radiation is placed in a photometer and its opaqueness recorded. Its opacity is then correlated with the opaqueness resulting from exposure to a known quantity of radiation, and thus the amount of radiation absorbed by the test film is ascertained and is recorded. To record the quantity of radiation absorbed by a chemical indicator, one visually compares the color of the irradiated liquid or solid to liquids or solids which have been exposed to known amounts of radiation. In cloud chambers, as was stated earlier, a photograph is taken of the track left by the ionizing radiation. This permanently records the event.

Recording Element for Conducting Detectors, Proportional, Geiger-Mueller, and Scintillation Counter Tubes:

In the most common cases where counter tubes are used, the recording



Courtesy Nuclear Instrument and Chemical Corp.

Fig. 7.—Recording Instrument of the Scaler Type.

A single electronic circuit containing a pulse amplifier, a scaler, high-voltage power supply, and recorder used in conjunction with pulse ion chambers, proportional counters, Geiger-Mueller counters, or scintillation counters. Before it is an array of various types of these sensing elements. It is instructive to realize the great variety of sensing elements there are, only a fraction of which are shown.

element consists of an amplifier, which can handle very high frequencies, a scaling circuit, and a recording element. A scaling circuit may be defined as an electronic circuit which divides by a constant factor the number of incoming repetitive signals, which are then recorded by a mechanical device. This scaling circuit may be based on the number 2 or on the number 10, being binary or decade stages, respectively. Both systems are widely used. The decade system appears to be more critical as to components. More uncommonly, rate meters take the place of scaling circuits. A rate meter may have either linear or logarithmic scales. For the various types of counter sensing elements, only the input amplifier varies with the change in element. Figure 7 illustrates a recording instrument of the scaler type which can be directly connected to nearly all types of sensing elements, as the photograph depicts.

While discussing recording elements for pulse registering devices, a few words might be given concerning coincidence and anticoincidence circuits and their uses. A coincidence electronic circuit uses two or more sensing elements. When two of these elements are activated by the same bundle of radiation energy and the register is caused to operate, these sensing elements are said to be operating in coincidence. If, however, the circuit is

arranged such that if these two sensing elements, which operate from the same bundle of energy, do not cause the register to record, then the circuit is said to be anticoincident. Coincident and anticoincident circuits are used in cosmic ray and other laboratory studies to blank out an undesired resultant, to achieve a directional effect, or to study decay schemes of isotopes.

Recording Element for Ion Chambers:

Whereas each of the sensing elements described above is a single-event device, an ion chamber typically gives a constant flow result; that is, the electrons arriving at the anode are not treated as distinct clouds as in the counter described in the above paragraph but as a constant current. Large ion chambers thus have what is called an amplifying circuit of the direct-coupled type; that is, there is no condenser between the ion chamber and the electronic circuit in the first amplification stage. The amplified current, proportional to the radiation flux, is read from a current meter, generally of the D'Arsonval type.

SUMMARY

There have been outlined above the characteristics of six different types of nuclear radiations, the advantages and disadvantages of the eight types of instruments for detecting and counting

these radiations, and the kinds of electronic circuitry associated with these instruments. As a background for the whole analysis, it should be pointed out that nuclear energy is still in its infancy. It is in a stage which may be thought of as comparable to that of coal energy at the time of James Watt, who developed the steam engine in the early nineteenth

century. The utilization of nuclear energy presents a tremendous challenge to America—to the present companies who are exploring its possibilities today and to the youth of America, who will make up the companies of the future. Significantly, so far nuclear energy has been developed largely by Federal Government expenditures. If, how-

ever, continued and rapid progress is to be made in the application of nuclear energy, it behooves free private enterprise actively to explore and to exploit the possibilities it offers, so that expansion in its application will proceed in the indomitably energetic manner which has characterized and developed this country in the past.

An Improved Fadeometer^{*}

By Ladislav Boor¹ and Seymour L. Trucker¹

SYNOPSIS

Three of the important factors which determine the chemical changes associated with weathering are light, temperature, and moisture. In commercial machines designed to simulate outdoor weathering, these factors are not controlled to the degree of precision comparable to that of the various instruments now in use for measuring changes in such properties as reflectance and transmission.

A weathering apparatus using the Atlas type enclosed arc as the light source has been built in which the temperature and relative humidity of the air in contact with the specimens are controlled and are variable over a wide range of ambient conditions. The design of the apparatus and the means of achieving control of these variables are described. The effect of varying ambient temperatures and relative humidity during fading tests on National Bureau of Standards Paper 1554 are shown.

Studies of fading rates made under the same variable conditions on textiles and plastics confirm the importance of close control of ambient temperature and relative humidity during light exposure.

DURING the expansion, 1948-1949, of the scope of activities of the Chemicals and Plastics Section of the Office of the Quartermaster General, laboratory facilities were organized at the Philadelphia Quartermaster Depot for evaluation of Quartermaster materials utilizing plastics in their construction. Among the useful tools for judging the suitability of a material for outdoor use is the accelerated weathering test employing some form of high-intensity light source. However, in these machines in the commercial form available there was much to be desired in the control of two of the factors, namely, temperature and humidity, which are known to be important in their effect on the manner and rate of degradation.

Since the light sources commonly used, such as arc lamps, are also good sources of the longer heat rays, the

problem of control of the temperature of the specimen during irradiation was early recognized, and means were provided for cooling specimens by a stream of air drawn from the room by a blower. This air as encountered in nonconditioned areas in the temperate zones may be anything from about 20 to 70 per cent relative humidity, and when raised in temperature during heat exchange to 140 or 150 F would suffer a drop in humidity, and any specimen of normal moisture content would be practically dehydrated. The frequently described discrepancies between outdoor sunlight exposures and such accelerated tests were long suspected to arise from the anhydrous condition of exposed specimens and the concomitant change of character and rate of degradation reactions.

R. O. Hall (1)² in 1933 measured relative humidities corresponding to 6.9 to 9.6 per cent at the exposed face of a test material in the CV model of Fadeometer, and described a thermostat and humidifier (steam or centrifugal

vaporizer) to maintain the humidity of the incoming room temperature air at 65 per cent, controlled by means of a hair hygrometer.

The National Bureau of Standards began systematic investigation of accelerated fading machines for evaluating permanency of textile dyes during the middle '20's, and Appel, Cady, Smith, Launer, and their associates have added immeasurably to the techniques of accelerated fading tests. Appel (2) showed that the behavior of certain dyes under exposure to light was different when the surrounding humidity was varied from 31 to 75 per cent. Launer (3), during the development of the standard dyed papers for calibration of light intensity, tested the standard paper and various dyeings at 38 C and 13 per cent relative humidity, and at 54 C and 37 per cent relative humidity. He found that, in 20 out of 42 dyeings, the rate of fading was affected by the temperature and humidity in the range cited. He pointed out the desirability of standardizing such factors as relative humidity, type of arc, voltage, and temperature.

In the FDA-R Fadeometer, the tendency for specimens under exposure of the arc lamp to dry out is reduced by introducing a humidifying system of open-mesh cotton fabric, stretched over boxlike frames and kept moist by being partly immersed in a water pan through which the cycling, cooling blower delivers its air stream. The effectiveness of this system in raising the relative humidity of the air in contact with the specimens is more apparent than real.

Nordhammar (4) investigated temperatures and humidities existing in the Fadeometer during normal operation and found that the number of specimen holders exposed influenced the temperature attained and that the relative humidity at an air temperature of 131 F inside the instrument, with the wick

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

^{*} Presented at the Symposium on Plastics Testing—Present and Future, Fiftieth Annual Meeting of the Society, June 23-27, 1952.

¹ Department of the Army, Quartermaster Research and Development Laboratories, Chemicals and Plastics Div., Philadelphia, Pa.

² The boldface numbers in parentheses refer to the list of references appended to this paper.

system in operation, was of the order of 11 per cent. With masterful understatement, he says: "In an ordinary Fadeometer, there is no risk of reaching 50 per cent (RH) prescribed as the maximum value in the AATCC Specifications for light fastness testing." He described several simple modifications which effectively increased the cooling effect, and he was able to raise the relative humidity of the ambient air stream to about 28 per cent. He did not measure the effect of this increase in humidity, but pointed out the limitations of the wick system for humidification and indicated the need for "some effective humidifier" with "some automatic control device."

Recent confirmation of the importance of control of humidity of the air surrounding the samples was presented by E. Van den Heuvel (5). He introduced a saturating trough of Rashig Rings and water spray through which a high capacity blower sucked room temperature air and saturated it. The volume of air handled was about four times the rate of the normal machine, and hence the temperature rise of air in its passage through the exposure chamber was only 4 to 5 C and the relative humidity of the exit air was 65 ± 2 per cent. No actual temperatures are given, but assuming 75 F room temperature, a 9 F rise would mean about 84 F for the exit temperature of the air. Tests made on dyes whose fading behavior depends on relative humidity confirmed that the color changes observed during outdoor sunlight exposure were duplicated by the modified Fadeometer with 65 per cent relative humidity in the exit air, as compared to the normal Fadeometer (low relative humidity) where the color changes were qualitatively entirely different from those produced by sunlight.

It is probable that other hydrophilic substances such as paper, natural and synthetic fibers, and plastics would fade, discolor, or deteriorate according to chemical mechanisms and at rates dependent on the moisture content of the exposed sample. If the latter is determined by the equilibrium between the sample and the surrounding atmosphere, it is desirable that this atmosphere be controlled to a higher degree of precision than obtainable in the presently available commercial machines.

Figure 1 shows a temperature chart made by a thermocouple in the plane of the specimen of the FDA-R Fadeometer, during normal operation, with the corresponding trace of the time of operation of the blower motor. The range of 20 F, resulting from the cycling of the blower, is rather wide for a test in which the temperature should be under control. The cooling effect derives from

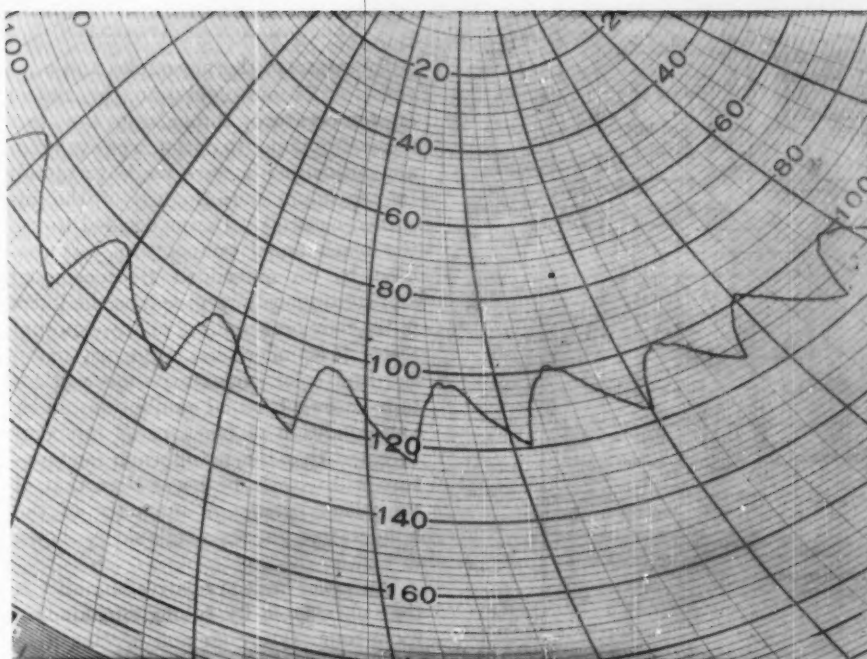


Fig. 1.—FDA-R Fadeometer Temperature.

the volume and temperature of the air blown past the specimens; thus the shape and period of the heating and cooling curves depend on the ambient conditions surrounding the machine and the volume of air (as affected by the cleanliness of the air filter and the rotor vanes of the blower). In the light of the deficiencies of the commercial machines for this purpose, it was decided to explore the possibility of correcting these shortcomings by improvements in basic design without making the apparatus too complicated and expensive for general use.

DESIGN LIMITATIONS

Light Source:

The type of light source was not studied as a variable, and the enclosed single arc of the standard Fadeometer was used. Improvement was sought in uniformity of exposure over the 5-in. vertical specimen height of the Fadeometer.

Temperature and Humidity:

No attempt was made to reduce temperature or dew point (by refrigeration) of the air passing through the machine; that is, unconditioned, room temperature air as is normally encountered during the annual seasonal cycle was used for cooling the samples. This ranged from about 75 F, 10 per cent relative humidity during the winter to about 90 F and 60 per cent relative humidity under extreme summer conditions. At high air temperatures, cooling effect was improved by the high volume of air

flow past the samples. To raise humidity in the apparatus, moisture would be added in the form of mechanically dispersed droplets, and their vaporization would add to the cooling effect.

It is seen that, in general, the apparatus remains the same as the present Fadeometer, with additional provisions for control of internal temperature and for increase and control of internal relative humidity.

DESIGN AND OPERATING CHARACTERISTICS OF EXPERIMENTAL FADEOMETER

The arc and its electrical controls, sample drum, sample capacity, rate of rotation, and spacings are identical with the FDA-R Fadeometer.

Since it was essential that any condition in the test space should be maintained without contamination by outside air, the test chamber itself was redesigned to be air tight, with soldered and welded seams in all joints in the test space and connecting air passages. The door is of the refrigerator type, with soft rubber gasket seal. Schematic diagrams of the principle of operation are shown in Figs. 2 and 3. One set of running conditions is shown in Fig. 2 in which the blower runs continuously, sucking in room temperature air at A, blowing it past the specimens and exhausting through B. The other extreme is shown in Fig. 3, where the butterfly valve closes off the inlet and exhaust passages and all air is recirculated. By modulating the position of this butterfly valve, a combination of fresh and

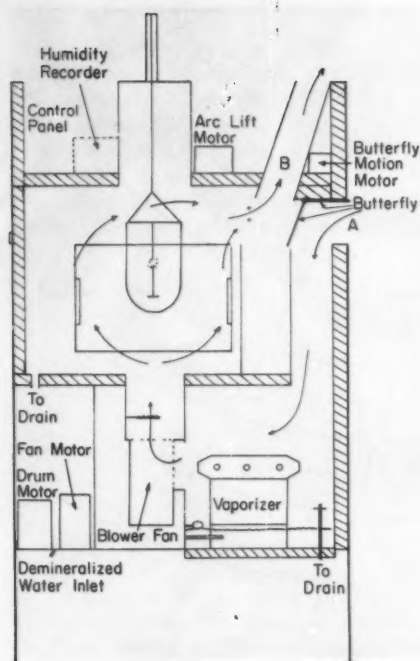


Fig. 2.—Air Circulation Diagram of Boor-Quartermaster Fadeometer.

recirculating air can be mixed to achieve any temperature between that of the incoming air and the temperature developed by complete recirculation past the arc. This control is located at the point C, just past the circulating blower, and it serves to energize a reversible motor which turns the butterfly valve through the angle between the two control positions.

In the path of incoming air, at D, is located a centrifugal atomizer, capacity of about 1 gal per hr which, when running, throws a fine mist of water into the air stream. Its operation is controlled by a wet bulb thermometer at E. Adjacent to it is a dry bulb which records (but does not control) the dry bulb temperature. Both dry and wet bulb temperatures are recorded on a single instrument located at F. To improve the uniformity of fading over the test area, an oscillating vertical motion which moves the arc through a vertical distance of 5 in. with a $1\frac{1}{4}$ -min total time cycle was added.

For exploration of temperature, light intensity, and relative humidity existing at the specimen locations on the rotating sample drum, three pairs of slip rings with brushes were built into the lower end of the drum shaft so that temperature records could be made with thermocouples mounted on the rotating drum. A photograph of the complete unit is shown in Fig. 4.³

³ Constructed by Atlas Electric Devices, Chicago, Ill.

PERFORMANCE OF APPARATUS

By means of thermocouples and a recorder of 24-min revolution, the control of temperature throughout the test space, from inlet to outlet, was explored, and adjustments were made to obtain the optimum performance of the installed controls. It was decided to use the black panel temperature, as measured by an embedded thermocouple⁴ and continuously recorded, as the index of the temperature level of any exposure test. It is understood that every material and color under exposure will attain its own thermal equilibrium under any condition of black panel temperature and that this equilibrium temperature will usually be lower than that of the black panel. A summary of the temperature ranges available is shown in Fig. 5.

The lower limit of relative humidity is that obtainable by taking surrounding room temperature air and heating it to the ambient conditions at the specimen. This will usually be about 20 per cent relative humidity or less. The upper limit is set by the dew point of the air in contact with the coolest parts of the air ducts carrying the circulating air stream. Maximum humidities obtainable in this apparatus at various dry bulb air temperatures are shown in Table I. Any relative humidity between these limits is obtainable by the proper setting of the wet bulb control temperatures. Typical charts showing range of recorded temperatures for a fixed setting are

⁴ Embedded thermocouple readings and Weston thermometer readings were found to agree within less than 1 F. The thermocouple is more sensitive to the rapid changes inherent in the controls and lends itself to continuous recording.

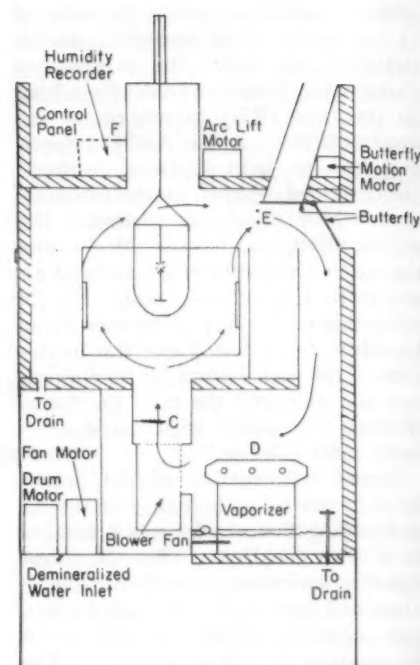


Fig. 3.—Air Recirculation Diagram of Boor-Quartermaster Fadeometer.

shown in Figs. 6 and 7 and Table II.

TEST RUNS

One of the first variables investigated was the uniformity of fading over the vertical exposure area, covering the 5-in. vertical space opposite the arc. Exploration of this test area by means of photo cells gave the typical light intensity distributions shown in Fig. 8. It is seen that the maximum intensity is in-



Fig. 4. Boor-Quartermaster Fadeometer

TABLE I.—MAXIMUM RELATIVE HUMIDITY^a.

| Setting | Ambient Room Air, deg Fahr | Black Panel, deg Fahr | Maximum Relative Humidity per cent. |
|---------|----------------------------|-----------------------|-------------------------------------|
| 12.... | 82 | 134-139 | 45 |
| 20.... | 80 | 151-157 | 52 |
| 24.... | 80 | 156-164 | 60 |
| 30.... | 81 | 164-168 | 53 |

^a No sample holders in drum.

TABLE II.—CONDITIONS DURING TYPICAL RUN.

| | Temperature, deg Fahr | | Relative Humidity, per cent |
|----------------------------|-----------------------|-----|-----------------------------|
| | Dry | Wet | |
| Ambient room.... | 96 | 73 | 32 |
| Black panel.... | 178-192 | .. | .. |
| Circulating air, exit..... | 124 | 97 | 35 |

variably observed, not horizontally opposite the arc, but in a direction slightly upward from horizontal. The explanation of this maximum at this angular location may lie in the intensely bright crater playing at the top surface of one of the lower carbons which the specimen "sees" from a location slightly above the horizontal. If, at the start of the run, this peak is located to coincide with the top edge of the 5-in. test space, the normal downward movement of the arc, incident to the burning of the lower carbons is about $1\frac{1}{2}$ in., and hence, the peak would not sweep over the 5 in. vertical space during a normal run of carbons.

Test runs of 17 hr were made, at 180 F black panel temperature, no moisture added (10 to 20 per cent relative humidity), to explore the effect of vertical motion of the arc:

1. Two runs with arc located $1\frac{1}{2}$ in. below the level opposite center of the 5-in. test area.

2. Two runs with arc oscillating over an amplitude of 5 in. between the limits $\frac{1}{2}$ in. below top of sample to $\frac{1}{2}$ in. below bottom of sample, as measured with fresh carbons.

National Bureau of Standards light sensitive paper No. 1554 was used as the test material^b and the Hunter Multipurpose Reflectometer with the green filter was used for all reflectance measurements. Specimens were measured, mounted in the top 2 in., middle 2 in., and lower 2 in., respectively, of the 5 in. high window of the normal specimen holders, exposed for 17 hr, and remeasured. A summary of the results is shown in Tables III and IV.

^b Light-Sensitive Paper No. 1554, "Directions for Use in Testing Textiles for Colorfastness to Light," Letter Circular LC1004 (Superseding LC934), National Bureau of Standards, Aug. 30, 1951.

Visual inspection of typical specimens from Runs Nos. 4 and 5 (fixed arc) representing center and end portions of the test space showed them to be different, and after consistent and repeated identification of the light and dark specimens by both color matchers and untrained laboratory personnel, it was decided that the use of the oscillating arc improved uniformity of fading over the test area.

The selection of 180 F black panel temperature for the runs described and for a great deal of exploratory work on the effect of relative humidity, requires some explanation. Bearing in mind that this test is intended to simulate outdoor sunlight exposure under nearly tropical conditions, data were sought concerning black panel temperatures attained, for instance, in South Florida, during the periods of most intense solar

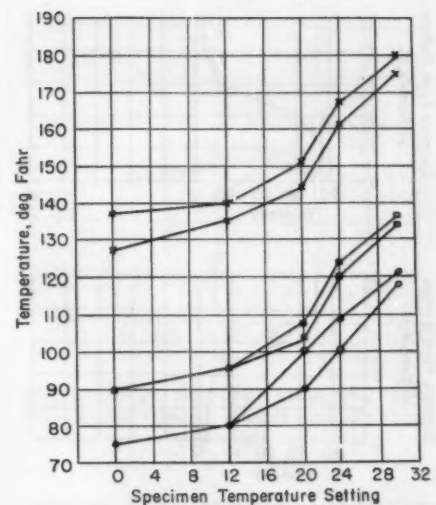


Fig. 5.—Temperature versus Specimen Setting.

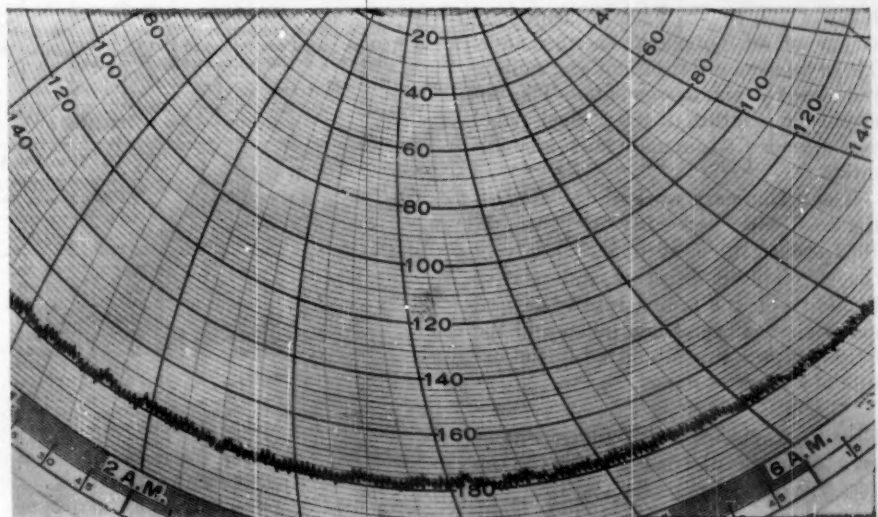


Fig. 6.—Black Panel Temperature.

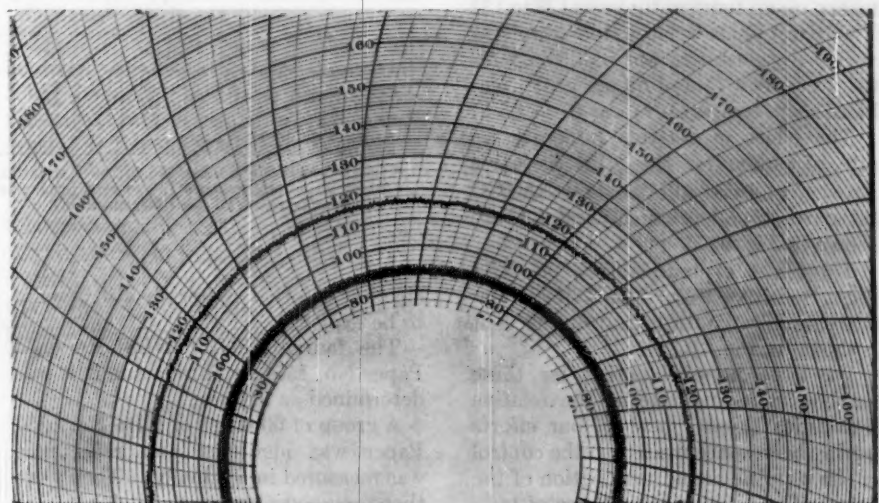


Fig. 7.—Wet and Dry Bulb Temperature.

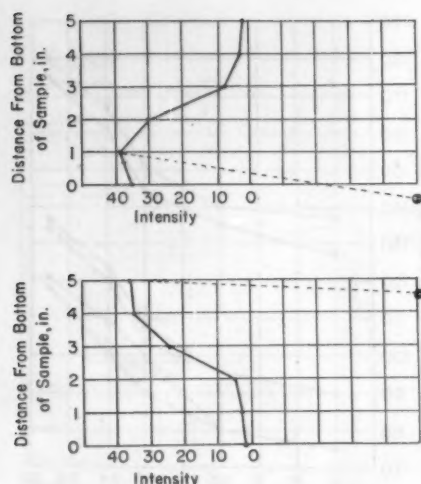


Fig. 8.—Light Intensity versus Position Along Sample.

radiation. The consensus from several sources was somewhere in the neighborhood of 170 to 175 F, as measured by means of an embedded thermocouple. These maxima are transient and rapidly reduced by air movements. The selected temperature of 180 F black panel was intended to simulate such a condition.

The preliminary work on the apparatus was completed early in February, 1952. Since then, systematic study of the effect of temperature and relative humidity on the fading rate of several materials has been undertaken and the following data are submitted in the nature of a progress report.

FADING RATES OF NBS LIGHT SENSITIVE PAPER NO. 1554 AND STANDARD WOOL FABRICS L4 AND L2

Each run consisted of 10 specimens, measured for reflectance before and after 17 hr of exposure in the Fadeometer with black panel temperature of 180 to 200 F; test space air temperature was 128 to 132 F and test space relative humidity was varied (by means of wet bulb temperature) between 15 and 55 per cent; ambient room temperature was 67 to 85 F.

The effect of relative humidity on rate of fading for the NBS Sensitive Paper No. 1554 and the two AATCC standard wool fabrics, L2 and L4, are shown in Fig. 9.

The effect of temperature on NBS Light Sensitive Paper No. 1554 at relative humidity controlled at 30 per cent is shown in Fig. 10.

We have no explanation for these maxima in fading rate at the relative humidities shown, most of our efforts having been concentrated on the control of the conditions and verification of the data. The relative importance of temperature and relative humidity on fading

TABLE III.—FIXED ARC.

| Paper Number | Position | Run No. 4 ^a | | | Run No. 5 ^b | | |
|--------------|----------|------------------------|-------|--------|------------------------|-------|--------|
| | | Reflectance, per cent | | | Reflectance, per cent | | |
| | | Before | After | Change | Before | After | Change |
| 1..... | Upper | 13.45 | 22.40 | 8.95 | 13.70 | 23.05 | 9.35 |
| 4..... | Upper | 13.50 | 22.65 | 9.15 | 13.65 | 23.00 | 9.35 |
| 7..... | Upper | 13.50 | 22.60 | 9.10 | 13.65 | 22.90 | 9.25 |
| 10..... | Upper | 13.50 | 22.75 | 9.25 | 13.65 | 23.10 | 9.45 |
| 13..... | Upper | 13.60 | 22.60 | 9.00 | 13.65 | 23.05 | 9.40 |
| 16..... | Upper | 13.60 | 22.75 | 9.15 | 13.65 | 22.90 | 9.25 |
| 2..... | Middle | 13.55 | 23.05 | 9.60 | 13.80 | 23.45 | 9.65 |
| 5..... | Middle | 13.60 | 23.05 | 9.45 | 13.75 | 23.50 | 9.75 |
| 8..... | Middle | 13.65 | 23.05 | 9.40 | 13.75 | 23.55 | 9.80 |
| 11..... | Middle | 13.65 | 23.20 | 9.55 | 13.75 | 23.25 | 9.50 |
| 14..... | Middle | 13.70 | 23.10 | 9.50 | 13.75 | 23.50 | 9.75 |
| 17..... | Middle | 13.65 | 23.05 | 9.40 | 13.75 | 23.55 | 9.80 |
| 3..... | Lower | 13.40 | 22.55 | 9.15 | 13.65 | 22.85 | 9.20 |
| 6..... | Lower | 13.45 | 22.45 | 9.00 | 13.65 | 23.05 | 9.40 |
| 9..... | Lower | 13.45 | 22.65 | 9.20 | 13.65 | 23.25 | 9.60 |
| 12..... | Lower | 13.75 | 23.30 | 9.55 | 13.65 | 23.05 | 9.40 |
| 15..... | Lower | 13.75 | 23.05 | 9.30 | 13.65 | 23.00 | 9.30 |
| 18..... | Lower | 13.85 | 23.40 | 9.55 | 13.70 | 23.30 | 9.60 |

SUMMARY

| Position | Run No. 4 | | | Run No. 5 | | |
|---------------------------------|-----------|------|-------------------|-----------|------|-------------------|
| | High | Low | Average | High | Low | Average |
| Upper..... | 9.25 | 8.95 | 9.10 ^c | 9.45 | 9.25 | 9.34 ^c |
| Middle..... | 9.60 | 9.40 | 9.48 ^c | 9.80 | 9.50 | 9.71 ^c |
| Lower..... | 9.55 | 9.00 | 9.29 | 9.60 | 9.20 | 9.43 |
| Maximum difference ^c | ... | ... | 0.38 | ... | ... | 0.37 |

^a Black panel temperature 182 to 193 F, relative humidity 20 per cent.

^b Black panel temperature 186 to 200 F, relative humidity 10 per cent.

^c Between extremes in locations marked.

TABLE IV.—OSCILLATING ARC.

| Paper Number | Position | Run No. 1 ^a | | | Run No. 3 ^b | | |
|--------------|----------|------------------------|-------|--------|------------------------|-------|--------|
| | | Reflectance, per cent | | | Reflectance, per cent | | |
| | | Before | After | Change | Before | After | Change |
| 1..... | Upper | 13.70 | 23.50 | 9.80 | 13.50 | 22.65 | 9.15 |
| 4..... | Upper | 13.90 | 23.80 | 9.90 | 13.55 | 22.50 | 8.95 |
| 7..... | Upper | 13.70 | 23.45 | 9.75 | 13.65 | 23.00 | 9.35 |
| 10..... | Upper | 13.75 | 23.10 | 9.35 | 13.65 | 22.85 | 9.20 |
| 13..... | Upper | 13.70 | 23.25 | 9.55 | 13.55 | 22.85 | 9.30 |
| 16..... | Upper | 13.75 | 23.25 | 9.50 | 13.50 | 22.60 | 9.10 |
| 2..... | Middle | 13.75 | 23.50 | 9.75 | 13.55 | 23.05 | 9.50 |
| 5..... | Middle | 13.80 | 23.70 | 9.90 | 13.50 | 22.60 | 9.10 |
| 8..... | Middle | 13.90 | 23.80 | 9.90 | 13.55 | 22.70 | 9.15 |
| 11..... | Middle | 13.75 | 23.40 | 9.65 | 13.60 | 22.70 | 9.20 |
| 14..... | Middle | 13.70 | 23.55 | 9.85 | 13.55 | 22.70 | 9.15 |
| 17..... | Middle | 13.85 | 23.95 | 10.10 | ... | ... | ... |
| 3..... | Lower | 13.75 | 23.50 | 9.75 | 13.50 | 22.60 | 9.10 |
| 6..... | Lower | 13.85 | 23.90 | 10.05 | 13.60 | 22.80 | 9.20 |
| 9..... | Lower | 13.70 | 23.25 | 9.55 | 13.60 | 22.80 | 9.20 |
| 12..... | Lower | 13.85 | 23.95 | 10.10 | 13.45 | 22.50 | 9.05 |
| 15..... | Lower | 13.85 | 23.70 | 9.85 | 13.50 | 22.70 | 9.20 |
| 18..... | Lower | 13.70 | 23.55 | 9.85 | ... | ... | ... |

SUMMARY

| Position | Run No. 1 | | | Run No. 3 | | |
|---------------------------------|-----------|------|-------------------|-----------|------|-------------------|
| | High | Low | Average | High | Low | Average |
| Upper..... | 9.90 | 9.35 | 9.65 ^c | 9.35 | 8.95 | 9.18 ^c |
| Middle..... | 10.10 | 9.65 | 9.86 ^c | 9.50 | 9.10 | 9.22 ^c |
| Lower..... | 10.10 | 9.55 | 9.86 | 9.20 | 9.05 | 9.15 |
| Maximum difference ^c | ... | ... | 0.22 | ... | ... | 0.04 |

^a Black panel temperature 175 to 186 F, relative humidity 10 per cent.

^b Black panel temperature 175 to 189 F, relative humidity 16 per cent.

^c Between extremes in locations marked.

changes of other materials still remain to be explored.

The fading rate of NBS Standard Paper No. 1554 in Florida sunlight was determined as follows:

A group of 60 strips of NBS No. 1554 Paper was identified and reflectance was measured individually. They were then exposed, bare, at 45 deg facing south to unclouded sun on clear days

only, between the hours of 10 a.m. and 2 p.m., during the period April 7 to 15, 1952. Five samples were removed after each 2-hr exposure up to 20-hr total. All were then reconditioned at 73 F and 50 per cent relative humidity and remeasured. The observed reflectance changes are shown in Fig. 11. It is seen that 14 to 15 hr of outdoor exposure under the described conditions is

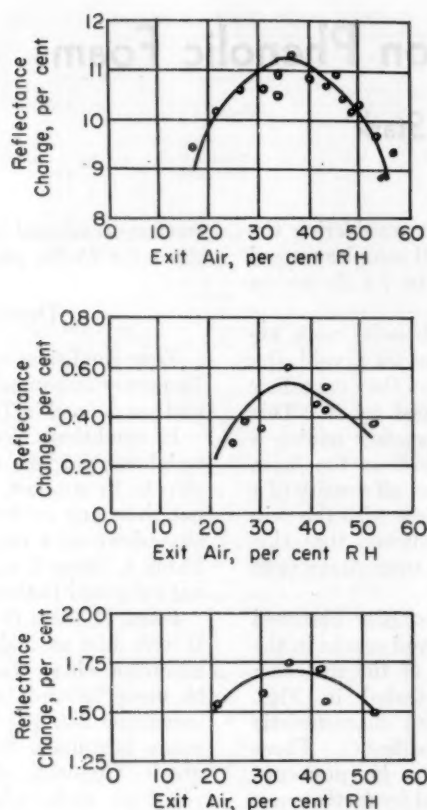


Fig. 9.—Reflectance Change versus Relative Humidity.

about equal to 17 hr of exposure in the new Fadeometer when the black panel temperature is 180 to 200 F and ambient air conditions are 130 F and 35 per cent relative humidity.

DISCUSSION

The work described covers performance of the first experimental model of this machine. Several modifications for improvement have been planned and will be tested in this model. The present design, intended for maximum flexibility and capacity for controlling and recording of critical temperatures, lends itself for research and exploration of a wide range of effects encountered during outdoor exposure. If a single climatic condition, such as, for instance, a typical South Florida condition, were agreed upon, the machine could be designed for this single condition with elimination of the more complex controls and recorders. Such a condition might

be defined by the following temperature limits:

| | |
|------------------------------|----------------|
| Black panel..... | 170-180 F |
| Circulating air, outlet..... | 130 F dry bulb |
| Circulating air, outlet..... | 100 F wet bulb |
| Relative humidity..... | 35 per cent |

This condition can be achieved with the apparatus described, during the entire year, using room temperature ambient air (unconditioned) as the only cooling medium.

Acknowledgments:

The authors wish to express their indebtedness to Messrs. J. W. Lane and J. E. Norton, of the Atlas Electric Devices Co., for their collaboration in the design and construction of this unit; to Mr. W. D. Appel and his staff at the National Bureau of Standards for helpful suggestions; to Mr. E. M. DeNoon, of the South Florida Test Service, for climatic data; and to the Office of the Quartermaster General for permission to publish this paper.

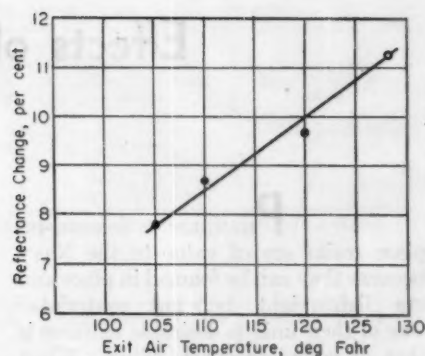


Fig. 10.—NBS Standard Paper No. 1554 Reflectance Change versus Exit Air Temperature.

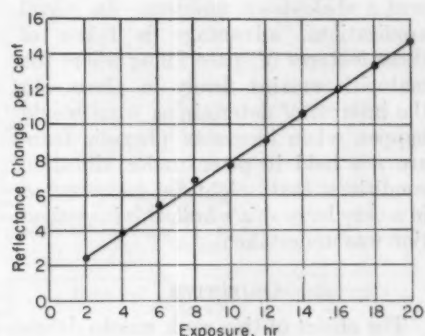


Fig. 11.—Reflectance Change versus Florida Sun Exposure Time.

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Effects of Vibration on Phenolic Foams

By H. J. Stark¹

PHENOLIC foamed-in-place resins are of value to the Navy because they can be foamed in place and are lightweight buoyant materials.² One of their unique desirable features is that of complete space filling. When the material is expanded in place the space is automatically filled; the material is not free to move around under vibration conditions and does not present a shakedown problem. In Naval applications, advantage is taken of these features of space filling where the material remains firmly in place. In the interest of determining what would happen when blocks of phenolic foam are not held in place under vibration conditions that might be encountered in a very large ship's hull, this investigation was undertaken.

OBJECTIVE

The object of this work was to determine the resistance or lack of resistance of foamed phenolic resin to vibration. The materials were vibrated with and without the skin formed during expansion, the material being confined in a wooden container or permitted to move around within the wooden container during the vibration test. The effect of density on vibration resistance was also observed.

The materials included in this investigation were phenolic foam C, modified phenolic foam C, phenolic foam B, and balsa wood. Phenolic foam C and phenolic foam B are commercially obtainable products. Samples for test were prepared in accordance with manufacturer's instructions. Modified phenolic foam C is essentially phenolic foam C to which has been added approximately 1 per cent of another resin and the mixture stirred for 25 min before the addition of the activator (or acid catalyst) at the time the samples are prepared. Stirring for this period improves the foam's texture.

MATERIALS

Phenolic foam C samples, modified and unmodified, ranged in density from

1.4 to 2.5 lb per cu ft considering the skin. Phenolic foam B samples ranged in density from 1.88 to 7.4 lb per cu ft considering the skin.

When the liquid phenolic resin expands in a container to fill a void, the material adjacent to the container cools first and is shaped by it. This produces a skin or a surface having a slightly higher density than the foam itself. It raises the over-all density of a piece compared to a piece with the skin trimmed off. It is believed that this skin contributes to the over-all strength of a foamed piece.

Phenolic foam B samples observed before vibration displayed cracks in the cut and skin surfaces of the material. These are well illustrated in Figs. 6 and 8 and are more characteristic of foam B than C or modified C. These cracks are believed to be post-cure shrinkage cracks caused by further cure of the foam upon standing at room temperature. This characteristic is also related to the basic nature and cure mechanism of phenolic foam resin.

Phenolic foam C and modified phenolic foam C did not exhibit post-cure cracks but did appear to have a few more fairly large surface voids.

The balsa wood used had a density of 8.5 lb per cu ft. The test specimen was made up of blocks held together with $\frac{3}{8}$ -in. square wooden pegs. Balsa wood has been used to fill certain voids in some ships. There were no data available concerning its behavior under vibration conditions. Balsa wood was included in this program to obtain these data and to provide a basis for comparison of the phenolic foams.

METHOD OF TEST

The vibration equipment used in these tests was a 100-lb capacity machine made by the Vibration Specialty Co. The test frequency was 30 cycles per sec. The amplitude was 0.030 in. (single amplitude). The direction of vibration was threefold. (A three-dimensional motion is obtained by mounting the test specimen on a bracket which is attached at a 45-deg angle to a plate. The plate is driven by an eccentric which causes the plate to describe a circular motion. Whereas a point on the plate describes a circular motion as a result of the eccentric drive, a point on the bracket gives motion in the third dimension also by the fore and aft

motion occasioned by its moving up and down the 45-deg plane.)

DISCUSSION

Four conditions of test at the stated frequency and amplitude were employed and are defined in Table II.

In conditions Nos. 1 and 2 the material was not free to move in relationship to its support. Since foam C did not show any evidence of crumbling or shakedown as a result of this test (see Table I, items 1 and 2), Foam B was not subjected to these two conditions.

Foam C, foam C modified, and foam B with skin on 5 sides were subject to vibration where the specimen was free to move around inside the container (condition No. 3). The container used was a box made from $\frac{1}{2}$ -in thick plywood. One-inch clearance was provided on each side of the specimen. The foam C and modified foam C retained 70 to 75 per cent of volume (see items 5 and 7 of Table I). Foam B (items 13, 14, and 16, Table I) in densities of 3.2, 4.7 and 7.6 lb per cu ft displayed volume losses in direct ratio to density increases. The lighter weight material retained greater volume after test. This is not what might be expected because compressive strength of the phenolic foams as well as most other cellular materials increases with increases in density. However, the lighter weight foams may not strike the container with as much force as the heavier foam.

The three phenolic foams were then tested with skins removed as in condition No. 4 (Table II). The results indicate that the skin does not contribute appreciably to their resistance to shakedown due to vibration when the foam is free to move inside a closed container.

The results displayed a varied volume retention picture ranging from 95 per cent retention to complete disintegration. Examining these results more in detail, we see foam C (items 3 and 4, Table I) retained 75 and 95 per cent volume. Specimen CA (foam C, item 4, Table I) was vibrated an additional 24 hr and retained 68 per cent volume after a total of 48 hr. It was believed that the modified foam C would retain more volume than foam C. This was not the case by a fairly large margin (see item 6, Table I) as only 60 per cent volume was retained. The densities of foam C

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

¹ Bureau of Ships, Department of the Navy, Washington, D. C.

² See H. J. Stark, J. Alpert, and T. L. Shoemaker, "Buoyancy Characteristics," *Journal American Society Naval Engineers*, Vol. 62, Feb., 1950, pp. 139-144.

TABLE I.—PHENOLIC FOAM C, MODIFIED PHENOLIC FOAM C, PHENOLIC FOAM B, AND BALSA WOOD.

| Item | Material Composition and Sample Designation | Preparation of Sample | Condition of Vibration | Density of Sample, lb per cu ft | Weight of Sample, lb | Dimensions of Sample, in. | Observations Before Vibration | Observations After Vibration, 24 hr | Observations After Vibration, 48 hr |
|------|---|---------------------------------------|---|---------------------------------|----------------------|--|---|--|---|
| 1. | Phenolic foam C | Skin on 5 sides | In container. No clearance | 2.5 | 4.75 | 14 $\frac{3}{4}$ by 14 $\frac{3}{4}$ by 15 $\frac{1}{2}$ | Few voids | No crumbling. No physical break-down. No weight or volume loss | Not determined |
| 2. | Phenolic foam C. Specimen CX, Fig. 1 | Skin removed on 6 sides | Bonded on bottom side to flat wooden surface with Acryloid cement | 1.5 | 2.3 | 13 $\frac{1}{4}$ by 13 $\frac{3}{4}$ by 15 $\frac{1}{2}$ | Few voids | Same as above | Not determined |
| 3. | Phenolic foam C. Specimen CX, Fig. 1 | Skin removed on 6 sides | 1-in. clearance on all sides of specimen. Specimen free to move. Container size, 15 $\frac{1}{4}$ by 15 $\frac{1}{2}$ by 15 $\frac{1}{2}$ in. | 1.4 | 1.92 | 13 $\frac{1}{4}$ by 13 $\frac{3}{4}$ by 13 $\frac{1}{2}$ | Few voids | Retained 75 per cent original volume and 90 per cent weight. Size, 12 $\frac{1}{2}$ by 11 by 13 in. Density, 1.7 lb per cu ft | Not determined |
| 4. | Phenolic foam C. Specimen CA, Figs. 2, 3, 4 | Skin removed on 6 sides | 1-in. clearance on all sides of specimen. Specimen free to move in container. Container size, 14 by 14 by 14 in., inside dimension | 1.75 | 1.75 | 12 by 12 by 12 | Close texture, large voids on bottom | Retained 95 per cent original volume. Weight, 1.65 lb. Size, 11 $\frac{1}{2}$ by 11 $\frac{1}{2}$ by 11 in. | Retained 68 per cent original volume. Size, 10 $\frac{1}{2}$ by 11 by 10 in. |
| 5. | Phenolic foam C. Specimen CB, Figs. 2, 3 | Skin on 5 sides | Same as item 4 | 2.35 | 2.23 | 11 $\frac{3}{4}$ by 11 $\frac{3}{4}$ by 12 | Many voids especially on bottom | Retained 75 per cent original volume. Weight, 1.69 lb | Not determined |
| 6. | Modified phenolic foam C. Specimen CC, Figs. 2, 3 | Skin removed on 6 sides | Same as item 4 | 2.1 | 2.08 | 11 $\frac{3}{4}$ by 12 by 12 | Uniform coarse texture. Few voids | Retained 60 per cent original volume. Specimen beginning to round. Weight, 1.3 lb | Not determined |
| 7. | Modified phenolic foam C. Specimen CD, Figs. 2, 3 | Skin on 5 sides | Same as item 4 | 2.78 | 2.55 | 11 $\frac{1}{2}$ by 11 $\frac{1}{2}$ by 11 $\frac{1}{2}$ | Uniform coarse texture. Few voids | Retained 70 per cent original volume | Not determined |
| 8. | Balsa wood. Specimen K, Fig. 5 | Pieces held together with wooden pegs | Same as item 4 | 8.45 | 8.45 | 12 by 12 by 12 | Uniform | No loss | No loss after 7 days |
| 9. | Phenolic foam B. Specimen BA, Fig. 7 | Skin removed on 6 sides | Same as item 4 | 2.7 | 2.7 | 12 by 12 by 12 | Slight crack on one surface | 85 per cent volume retained. Cracks—top 2 corners chipped. Size, 11 $\frac{1}{4}$ by 11 $\frac{1}{4}$ by 11 $\frac{1}{4}$ in. Weight, 2.4 lb | 70 per cent volume retained. Cracks—corners chipped. Size, 10 $\frac{1}{4}$ by 10 $\frac{1}{4}$ by 11 in. Weight, 2.15 lb |
| 10. | Phenolic foam B. Specimen BB, Fig. 7 | Skin removed on all 6 sides | Same as item 4 | 1.88 | 1.88 | 12 by 12 by 12 | Void at one corner | 65 to 70 per cent volume retained. Corners chipped. Weight, 1.1 lb | 60 per cent volume retained. No cracks. Corners starting to round. Weight, 0.85 lb |
| 11. | Phenolic foam B. Specimen BC, Fig. 7 | Skin removed on all 6 sides | Same as item 4 | 4.21 | 4.21 | 12 by 12 by 12 | Cracks and 3 voids on sides | 25 to 30 per cent volume retained. Cracks—corner chipped. Weight, 0.9 lb | Broken into 2 pieces |
| 12. | Phenolic foam B. Specimen BH, Fig. 6 | Skin removed on all 6 sides | Same as item 4 | 5.5 | 5.5 | 12 by 12 by 12 | Many cracks on all sides | Completely broken down into small pieces | Complete break-down. (No illustration) |
| 13. | Phenolic foam B. Specimen BD, Fig. 9 | Skin on 5 sides | Same as item 4 | 3.2 | 3.2 | 12 by 12 by 12 | Cracks on all sides. Skin cracking and pulling away from core | 75 per cent volume retained. Skin off on bottom, partially off on sides. Weight, 2.2 lb | Not determined |
| 14. | Phenolic foam B. Specimen BE, Figs. 8, 9 | Skin on 5 sides | Same as item 4 | 4.7 | 4.7 | 12 by 12 by 12 | Cracks on all sides. Skin pulling away from core | 60 per cent volume retained. One entire corner missing. Skin off bottom and partially at sides. Weight, 2.5 lb | Not determined |
| 15. | Balsa wood. Specimen K-1, Fig. 9 | Pieces held together with wooden pegs | Same as item 4 | 8.5 | 8.5 | 12 by 12 by 12 | | 2 corners slightly fractured. One slight crack one side. Weight, 8.45 lb | Not determined |
| 16. | Phenolic foam B. Specimen BG, Fig. 9 | Skin on 5 sides | Same as item 4 | 7.6 | 7.4 | 12 by 11 $\frac{3}{4}$ by 12 | Cracks on all sides. Skin pulling away on top surface | 50 per cent volume retained. Skin off bottom and sides. Size, 11 $\frac{1}{4}$ by 11 by 6 $\frac{1}{2}$ in. Weight, 3.3 lb | Not determined |

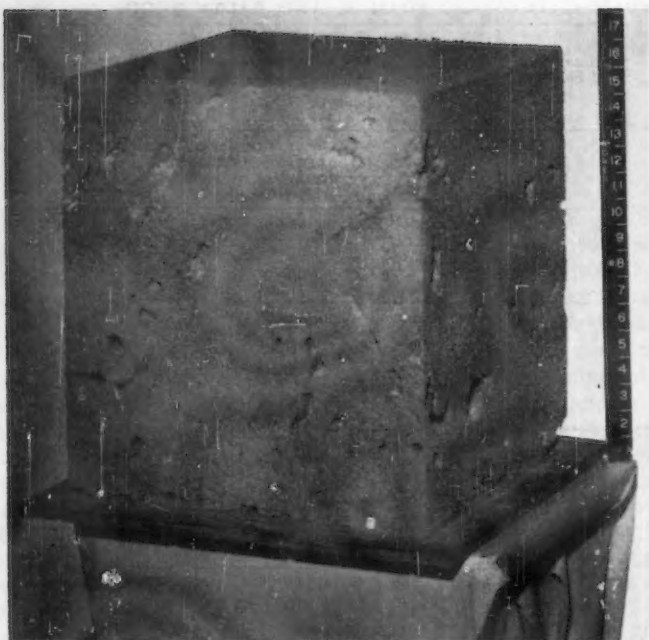


Fig. 1.—Specimen CX Phenolic Foam C with Skin Removed Bonded to Wood Pane Before Vibration.

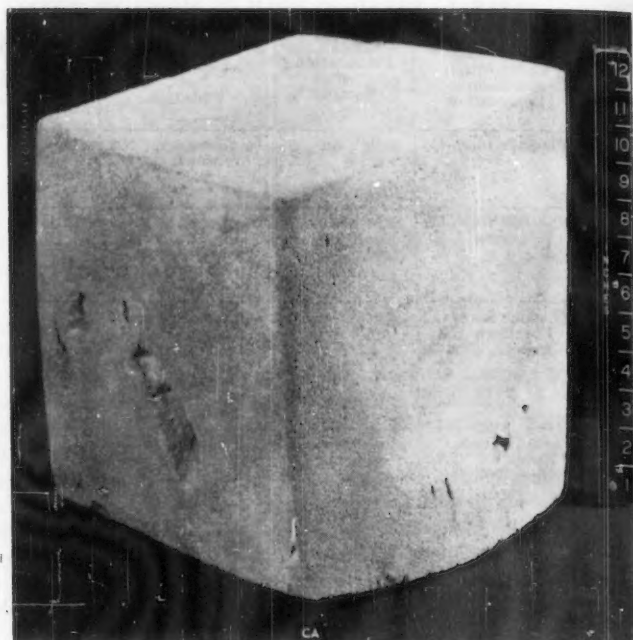


Fig. 4.—Close-up View of Specimen CA Phenolic Foam C Unmodified, Without Skin, After 48 hr Vibration.

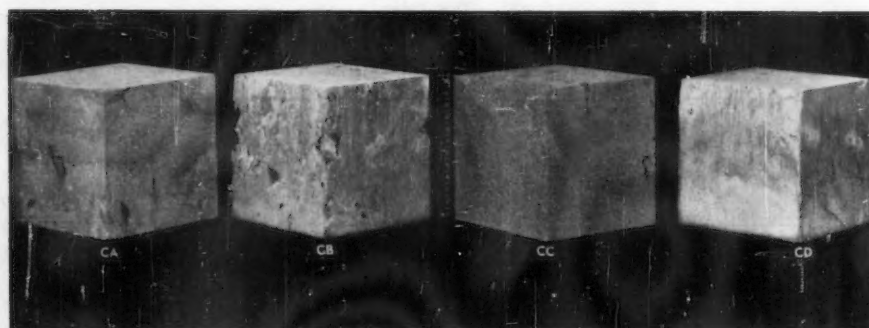


Fig. 2.—Phenolic Foam C Before Vibration.

Specimen CA not modified and skin removed.
Specimen CB not modified and skin not removed.
Specimen CC modified and skin removed.
Specimen CD modified and skin not removed.

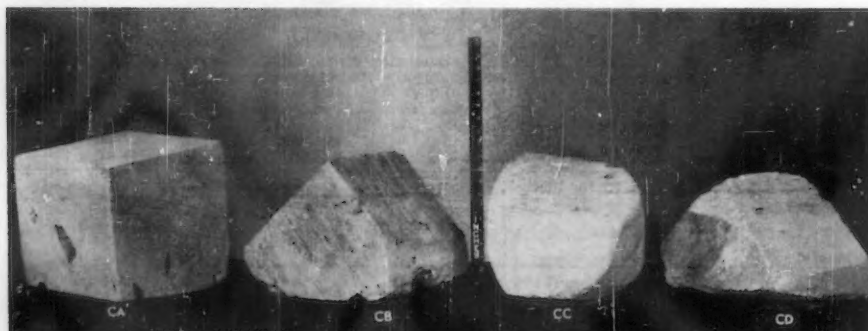


Fig. 3.—Phenolic Foam C After 24 hr Vibration.

Specimen CA not modified and skin removed.
Specimen CB not modified and skin not removed.
Specimen CC modified and skin removed.
Specimen CD modified and skin not removed.

and modified foam C are similar at approximately 2 lb per cu ft.

The results of test on foam B material where the effect of density on vibration may be observed are quite different from foam C. Foam B (items 9 and 10, Table I) of approximate comparable density (2.7 and 1.8 lb per cu ft, respectively) retained a fair amount of their volume even after 48 hr of vibration, namely 70 and 60 per cent.

We can say, however, that the resistance to shakedown and vibration of foam C, modified foam C, and foam B in densities between 2 and 3 lb per cu ft after 48 hr is comparable in that *volume losses not less than 40 per cent may be expected.*

TABLE II.—SUMMARY OF CONDITIONS AND MATERIALS.

| Condition | Material |
|---|---|
| No. 1.—Skin on 5 sides (not removed), no clearance | Foam C (item 1) |
| No. 2.—Skin removed, specimen bonded to vibration table | Foam C (item 2) |
| No. 3.—Skin on 5 sides, specimen free to move in closed container | Foam C (item 5) Foam C modified (item 7) Foam B (items 13, 14, 16) |
| No. 4.—Skin removed, specimen free to move in closed container | Foam C (items 3, 4) Foam C modified (item 6) Foam B (items 9, 10, 11, 12) Balsa wood (items 8, 15) |

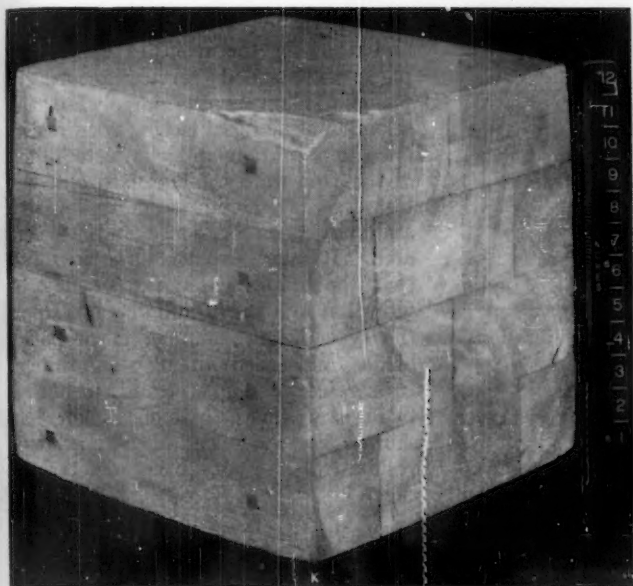


Fig. 5.—Close-up View of Balsa Wood Specimen K After 7 days Vibration.

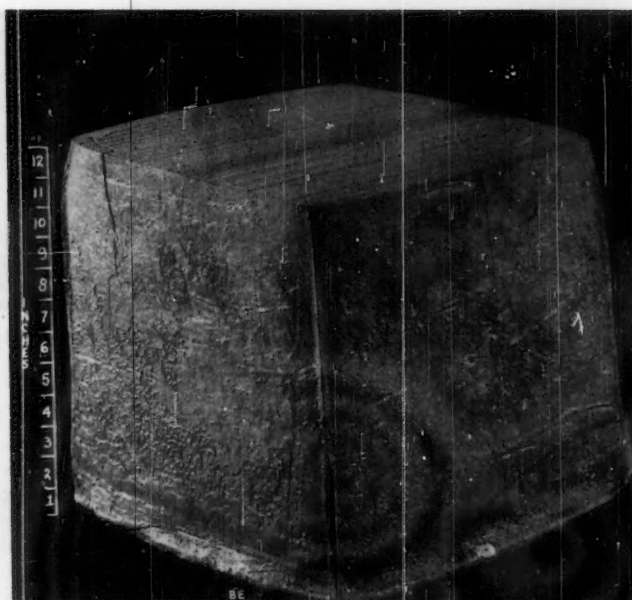


Fig. 8.—Close-up View of Specimen BE Phenolic Foam B with Skin Surface, Before Vibration (Note Cracks). Density 4.7 lb per cu ft.

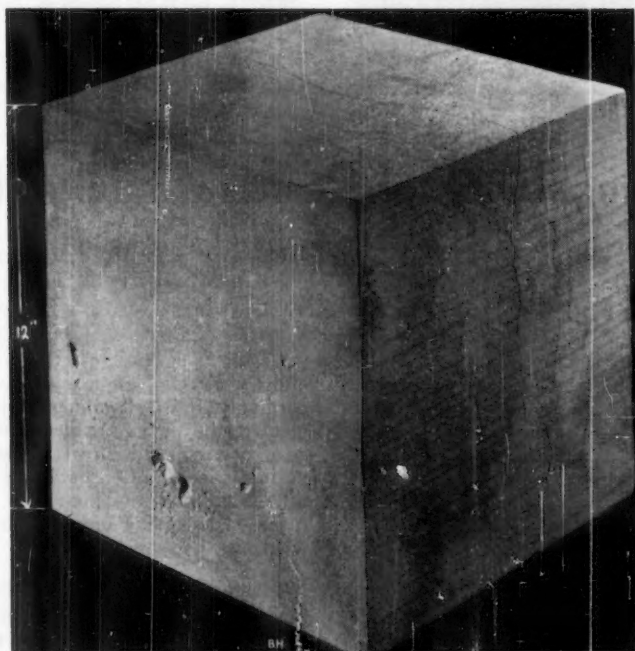


Fig. 6.—Close-up View of Specimen BH Phenolic Foam B with Skin Removed, Before Vibration (Note Cracks). Density 5.5 lb per cu ft.

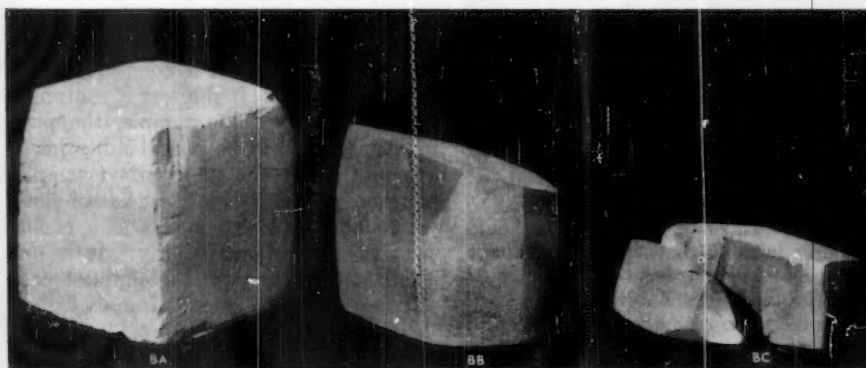


Fig. 7.—Phenolic Foam B Specimens with Skins Removed After 48 hr Vibration.

Examining foam B in the higher densities of 4.2 and 5.5 lb cu ft (condition No. 4, Table II, and items 11 and 12 of Table I), we see the 4.2-lb material to have *lost* considerable volume after 24 hr, namely 70 per cent, and after 48 hr to have broken into two pieces. Foam B (item 12, Table I) in 5.5 lb per cu ft density completely broke down during the test. The higher density foam B did not exhibit better resistance to shakedown and vibration as might be expected.

The balsa wood showed no volume loss after 7 days of vibration. This was to be expected because of the great difference in composition and strength compared to the phenolic foam materials.

GENERAL CONCLUSIONS

The conclusion of greatest significance obtained as a result of these tests is that the phenolic foams described in this report, with or without skins, when subjected to vibration of amplitude and frequency also herein described and given freedom to move inside a closed container, will lose volume, shake down, and powder. The degree of volume loss is somewhat variable depending upon the particular foam examined.

The utilization of phenolic foam in application where it is subject to vibration requires that the material be bonded in place or otherwise be firmly retained on all sides so that it is not free to move; otherwise volume loss can be expected.

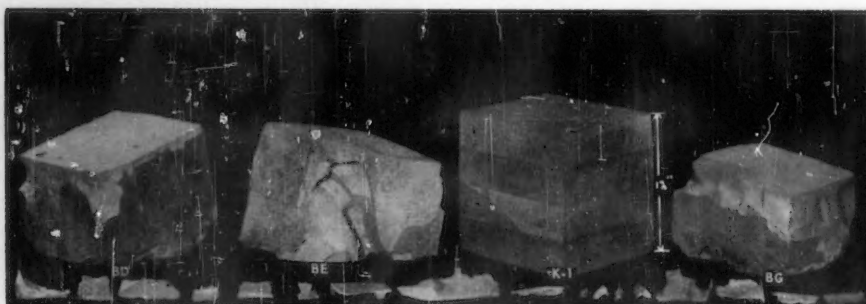


Fig. 9.—Phenolic Foam B Specimens with Skin and Balsa Wood After 24 hr Vibration.

Phenolic foam C, modified phenolic foam C, and phenolic foam B in density ranging between 2 and 3 lb per cu ft have comparable vibration or shakedown resistance when vibrated in a closed container, without skins, and permitted to move. Their volume loss will be about 40 per cent after 48 hr.

The skin formed on phenolic foam does not contribute appreciably to its resistance to shakedown due to vibration when it is free to move inside a closed container. The higher density foam B

material does not have better resistance to vibration or shakedown.

Phenolic foams that exhibit cracks in the skin or body of the material where the skin has been removed are more susceptible to volume loss and shakedown than those that do not exhibit these post-cure shrinkage cracks.

The Bureau of Ships in applications involving phenolic foam has taken advantage of the foaming in place feature. The material in all cases has been firmly held in place such as is obtained by

pouring the liquid resin into a cavity and allowing the resin to expand in place. The good service record of phenolic foam is due largely to the selection of material having good resistance to vibration and complete filling of the void spaces. The nature of the test described herein is one of severity and may even be considered accelerated. It must also be borne in mind that the amplitude and frequency of vibration in a ship's hull depends upon the type of ship, number of propeller blades, and speed, among other things. In service use up to and including two years afloat, phenolic foam has shown no evidence of shakedown, volume loss, or any other deleterious effect.

Acknowledgment:

The author wishes to thank the Bureau of Ships, Department of Defense, for permission to publish this paper. In particular, it is desired to thank Messrs. J. B. Alfors, L. E. Sieffert, R. R. Winans, J. Kaminetsky, and E. F. Noonan.

Laboratory Tests for Pumpability of Residual Fuel Oils

By V. L. Shipp¹ and L. D. Tredick¹

NEXT to the high caloric value, the most valuable property of petroleum fuel oils is their pumpability because it makes possible the application of simple means of transportation, storage, and controlled feeding to the burners. In the case of wax-free petroleum oils, the pumpability is a function of viscosity only and may be predicted from the viscosity-temperature curve. In the case of wax-bearing oils, the situation is complicated by the formation of wax gels which contribute to the immobility of the oil at low temperatures. It is natural, therefore, that many efforts have been made to develop a laboratory test capable of evaluating such products. The ASTM Method of Test for Cloud and Pour Points (D 97), in its original form,² was the

first recognized test in this country. By definition, the pour point is the lowest temperature at which the oil will move its meniscus when chilled *without disturbance* in a 1½-in. glass jar held in a vertical position and then tilted to a horizontal position. The force causing the flow or movement of the meniscus is the force of gravity alone.

The sponsors of the pour point test were aware of its limitation to gravity feed and similar low-dynamic head conditions as shown by the following quotation from the Report on Significance of Tests of Petroleum Products:³

The pour point gives an indication of the temperature below which it may not be possible to pour or remove an oil from its container, or below which it might be dangerous to use the oil in gravity lubricating systems, where the head tending to produce flow is small. However, it should be borne in mind that the size and shape of the container, the head or force exerted upon the oil, and the nature of its physical structure when solidified, all have an

effect upon its tendency to flow. Accordingly, it is self-evident that no single test can be devised which can be taken as a positive and direct measure of the performance of an oil under all conditions of service, and the pour test should be regarded as giving only an indication of what may be expected.

Inasmuch as pumping is the application of shearing stresses much greater than gravity to cause fluid flow, it is evident that the pour point test is unreasonably restrictive for predicting the pumpability of a product. In fact, everyone familiar with the pour point test procedure knows that simple stirring of a sample of a congealed waxy oil liquefies it. If the test is continued with stirring of the sample, the pour point found will be considerably lower than that of the undisturbed sample. Hence, the pour point test has obvious and inherent shortcomings as a means for predicting pumpability. It is unsatisfactory for even the simplest case of light-colored oils containing wax but little asphalt or resin.

Still greater complications are encountered with heavy black fuel oils,

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² Tentative Method of Test for Cloud and Pour Points of Petroleum Products (D 97-21 T), *Proceedings, Am. Soc. Testing Mats.*, Vol. 21, p. 674 (1921).

³ *Proceedings, Am. Soc. Testing Mats.*, Vol. 28, Part I, p. 485 (1928).

which contain both the wax and high-molecular materials such as asphalts, resins, and possibly other crystallization inhibitors. As long as 60 yr ago, when wax-bearing fuel oils of Roumanian origin appeared on the market, it was discovered that such fuel oils had no definite solidification point, or what we would now call "pour point." Holde,⁴ Tychinin,⁵ and other researchers⁶ demonstrated that the pour point of wax-bearing black fuels depended upon the thermal history of the sample. By preheating their samples to various temperatures they obtained pour point curves. The lowest pour point was obtained invariably on samples preheated to about 200 F or higher, but the highest pour point was obtained after preheating to various temperatures, depending upon the nature of the sample. The range of this preheating temperature for obtaining the maximum pour point was anywhere from 110 to 170 F.

The 1930 version⁷ of the ASTM Method D 97 was based on a cooperative survey of samples conducted by the ASTM Subcommittee XVI on Cloud and Pour Test,^{8,9} from which it was concluded that preheating to 220 F for the "low pour point" and to 115 F for the "high pour point" was satisfactory.

Continued work on waxy black oil products showed, however, very conclusively that the ASTM Method D 97 is not satisfactory. Individual oil companies resorted to a series of heating cycles to construct the whole pour point curve which, while an improvement of the pour test, did not eliminate basic shortcomings of the pour test from the standpoint of predicting the pumpability.

It is not the purpose of this paper to discuss the theoretical aspects of congealing of wax-bearing residual fuel oils. Considerable work has been done in this field and there are many conflicting schools of thought on the subject.

⁴ A. N. Sachanen, "Chemical Constituents of Petroleum," Reinhold Publishing Corp., New York, N. Y. (1945).

⁵ B. Tychinin, "Structure and Properties of Grosny Paraffinic Crudes and Residua," "Neftyanoye y Slantzevoye Khosyastvo" (Oil and Shale Industries, Russia), Moscow, No. 11-12 (1923).

⁶ B. H. Moerbeek and A. C. Van Beest, "Cold Test for Fuels," *Journal Institution Petroleum Technologists*, Vol. 21, p. 155 (1935).

⁷ 1930 Book of ASTM Standards, Part II, p. 481.

⁸ *Proceedings, Am. Soc. Testing Mats.*, Vol. 31, Part I, p. 468 (1931).

⁹ R. W. Moore and L. C. Beard, Jr., "A Microscopic Study of Certain Oils Which Show the Phenomenon of High and Low Pour Point," *Proceedings, Am. Soc. Testing Mats.*, Vol. 32, Part I, p. 402 (1932).

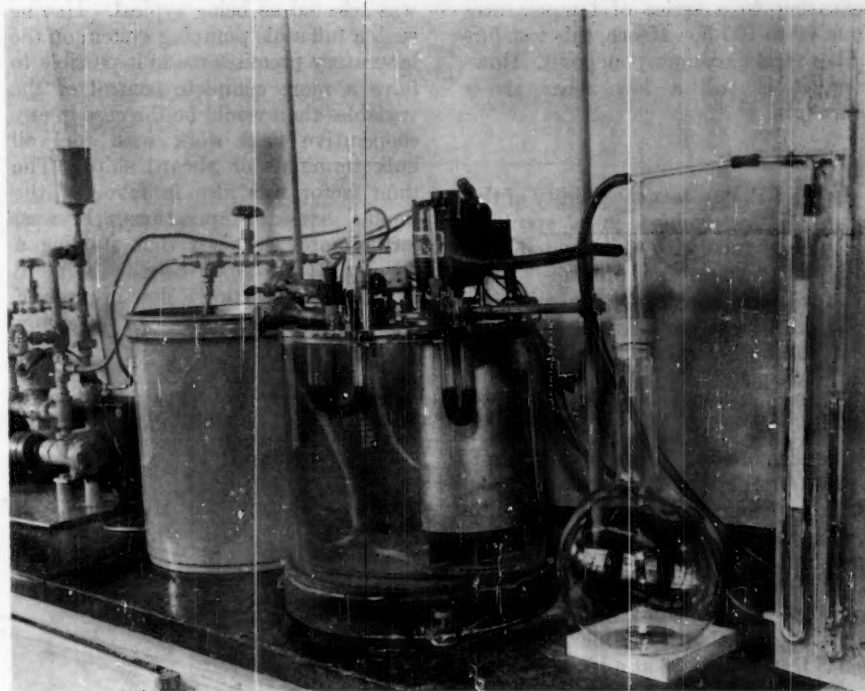


Fig. 1.—Modified P. and O. Fluidity Test Assembly.

The photograph shows on the extreme left a pump for circulating acetone through a coil in the metal bath on the left and through the bottom coil in the constant temperature glass bath in the center. The cooling of acetone in the metal bath is effected by acetone and dry ice. This part of the assembly represents the cooling system. The glass bath in which the U tubes are suspended has also provision for heating and automatically controlling the temperature up to 220 F. The glass flask on the right is a vacuum trap. Of the two mercury filled U tubes on the right, one is the vacuum meter (manometer) and the other an automatic vacuum controller.

Confusion arises from the fact that phenomena observed in wax-bearing lubricating oils are similar to those observed in black residual fuel oils. Attempts to apply experience gained in pour point depressant work on lubricants to that on black residua have been disappointing.

The present paper is concerned with the following practical questions:

What are the currently available laboratory tests for predicting the pumpability of heavy waxy fuels and which of these tests correlates most closely with actual full scale pumping.

To the best of our knowledge, there is no published information on this subject.

The following laboratory tests have been investigated at the Socony-Vacuum Laboratories:

- Pour Point Test.....
- Socony-Vacuum Maximum Pour Point Test
- Institute of Petroleum Flow Test.....
- Institute of Petroleum Setting Point.....
- Pressure Viscosity.....
- P. and O. Fluidity Test (Also known as
- Aramco 6-C Test) (see Fig. 1).....

Pour Point Test:

This ASTM pour point test is well known and requires no description. Suffice it to say that it includes preheating of the sample to two arbitrarily selected temperatures, 115 and 220 F. This test was devised for predicting the gravity flow characteristics.

The same comments apply to I.P. 15.42, which is the British equivalent of ASTM D 97 - 47.

SVM 201-50:

The SVM 201-50 procedure for maximum pour point determination is the ASTM pour point test with a complete freezing and preheating cycle added. The cycle consists of heating the sample to 212 F, splitting it into nine separate portions, cooling the latter to 20 F and

ASTM Method D 97 - 47 (British Equivalent I.P. 15.42)

SVM 201-50
Journal Institution Petroleum Technologists, London, 1935

I.P. Test Method 54-42
M. H. Arveson, *Industrial and Engineering Chemistry*, Vol. 24, p. 71 (1932)

Private release Arabian-American Oil Company

reheating to a series of temperatures from 90 to 190 F. Hence, this test furnishes a true maximum pour point. However, it is still a low shear stress procedure.

I.P. Flow Test:

In the I.P. flow test the fluidity of the sample is determined in a specially designed U tube with a graduated narrow leg, at 20 cm Hg pressure. This test provides for a greater shearing rate but has, in its original form, no provision for heating and cooling cycles of the sample.

I.P. Setting Point:

The idea of the I.P. setting point test is quite similar to that of the flow test. The design of the U tube is different, and the heat treatment of the sample consists of preheating to 212 F, followed by cooling to 40 to 50 F above the expected setting point. The setting point is essentially the "lower pour point" test conducted at a higher shearing rate (50 mm H₂O pressure).

Pressure Viscosity:

Pressure viscosity determinations have been made in equipment developed and described by M. H. Arveson for semifluid greases. Only a limited amount of experimentation was conducted, and work is continuing with modified equipment.

P. and O. Fluidity Test:

The P. and O. fluidity test, which has gained acceptance in evaluating Bunker C fuel oils in the Mediterranean and Middle East areas, is designed to give more significant results from the standpoint of low-temperature pumpability. The sample of oil is placed in U tubes of specified size and subjected to gradually increasing vacuum (up to 15 cm Hg) at one end of the U tube. The temperature of the surrounding bath is gradually decreased until the temperature is reached when the level of the fuel sample does not move. Fuels that still start moving within 60 sec at 32 F are considered as passing the P. and O. fluidity test. No preheating of the sample is included in this procedure. A photograph of the test equipment is shown in Fig. 1.

Since it was recognized that no laboratory procedure would be entirely satisfactory without the inclusion of some definite thermal treatment of the sample, all of the above tests were made with the addition of the SVM 201-50 heating and cooling cycles.

FUEL OIL PUMPING INSTALLATION

A fuel oil system as commonly used aboard modern tankers and cargo vessels

was selected as being typical. Having such a full scale pumping system on the laboratory premises made it possible to have a more complete control of the variables than would be the case in any cooperative field work with fuel oil bulk terminals or aboard ships. The time factor was also in favor of the smaller scale of operations. It was, furthermore, surmised that starting a flow in 2½-in. pipes usually is more difficult than starting a flow in pipes of larger diameters. Such an assembly

was erected in a cold room in the laboratory with facilities for cooling to any temperature down to 0 F. A study of fuel oil systems aboard typical cargo ships and oil tankers indicated that the following features would represent about the most difficult ones on ships.

| | |
|---|--------|
| Suction line to pump, maximum distance..... | 48 ft |
| Suction line lift..... | 10 ft |
| Suction line diameter..... | 2½ in. |

The pump used was the popular

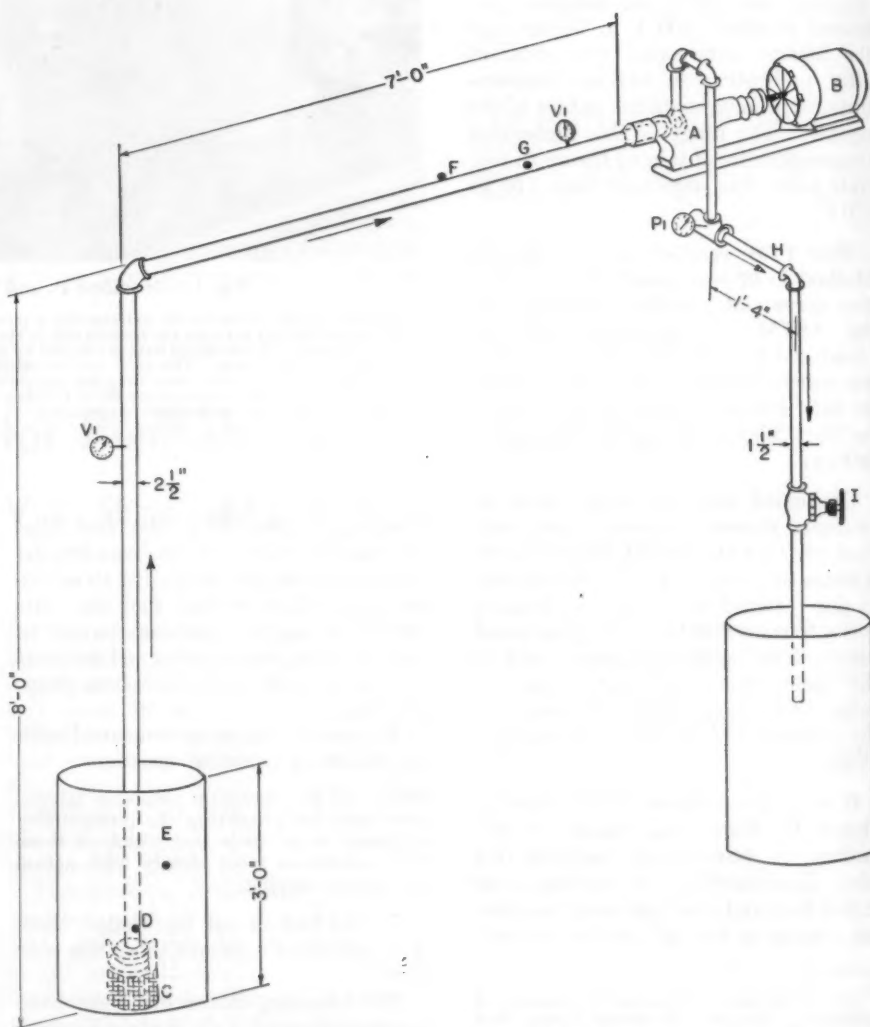


Fig. 2.—Bunker Fuel Pumping Unit.

- A—2½-in. Quimby screw pump 8.5 gal per min at 400 lb
- B—10-hp motor 1150 rpm
- C—O.P.W. No. 85 single flat poppet foot valve
- D—3-ft rod thermocouple taped to suction line
- E—3-ft rod thermocouple placed in middle of oil drum
- F—1-ft rod thermocouple taped to suction line
- G—6-in. rod thermocouple in suction line
- H—1-ft rod thermocouple taped on pressure line
- V₁—vacuum gages
- P₁—Pressure gage
- I—1½-in. gate valve

Equivalent Pipe Length for Suction Line

| | |
|--------------|--------------|
| 1-2 | 8 ft |
| 2-3 | 7 ft |
| Foot valve | 17 ft |
| 2LS | 16 ft |
| Total | 48 ft |

Quimby gear pump having a capacity of 8.5 gal per min. Other details including instrumentation are shown in Fig. 2.

Drum quantities of Middle East Bunker fuel oil were subjected to various heat treatments and tested for pumpability. The critical values considered in the pumping tests were the temperature at the intake of the suction line in the drum and the time for starting the flow at the discharge end.

Middle East residuum from an atmospheric vacuum pipe still and a Bunker C fuel oil produced by cutting back this residuum with less viscous components were used throughout the experimental work.

For the sake of brevity, experimental data on I.P. flow test, I.P. setting point, and pressure viscosities which did not show satisfactory correlation with actual pumpability data are omitted. Work on pressure viscosities is being continued. The pertinent results of the S-V maximum pour point and fluidity determinations are shown in Tables I and II, along with the results of the pumping tests in the cold room assembly.

The following will be noted in Tables I and II.

The upper ASTM pour point of the vacuum residuum is 70 F. The application of heat treatment according to SVM 201-50 discloses that the residuum has a 75 F maximum pour point. The P. and O. fluidity test shows that the product submitted to the worst possible preheating temperature or 130 F is still mobile at 40 F. The actual pumping experiments showed that the product is still pumpable at 44 F.

It is evident that the pour test in its original ASTM, or S-V form cannot be accepted as a measure of pumpability. Both are obviously too restrictive. The modified fluidity test, however, when supplemented by the S-V thermal cycle, gives a good check with actual pumpability. On the basis of the pour test, the product would have been declared unsatisfactory for pumping below 70 to 75 F, whereas it can be handled down to the temperature of 40 to 44 F.

A more complete presentation of the relationships between the maximum pour point SVM 201-50, the P. and O. fluidity test, and actual pumpability, is given in Fig. 3. Within the scope of operations presented, it appears that the P. and O. fluidity test is competent for predicting the pumpability with an accuracy of about ± 6 F, whereas the pour point values are more erratic and differ from the lowest pumpability points by as much as 30 F.

Attention is also called to run No. 4 in the pumpability assembly. This run proves that chilling of the oil below the

TABLE I.—LABORATORY TESTS FOR PUMPABILITY OF MIDDLE EAST RESIDUAL FUELS

| | Middle East Vacuum Residuum | Bunker C Fuel |
|------------------------------------|-----------------------------|---------------|
| Gravity..... | 18.3 | 19.1 |
| Flash point, deg Fahr..... | 345 | 290 |
| Viscosity SSF at 122 deg Fahr..... | 56 | 42 |
| Upper pour, deg Fahr..... | 70 | 70 |
| Lower pour, deg Fahr..... | 5 | 5 |

ASTM D 97-47

| S-V Pour Test (SVM 201-50) | | |
|---|----|----|
| Heat to 212 F, chill to 20 F and then preheat to: | | |
| 80 F..... | 20 | 20 |
| 90 F..... | 25 | 40 |
| 100 F..... | 60 | 60 |
| 110 F..... | 65 | 65 |
| 120 F..... | 70 | 70 |
| 130 F..... | 75 | 75 |
| 140 F..... | 70 | 70 |
| 150 F..... | 65 | 65 |
| 160 F..... | 65 | 65 |
| 170 F..... | 70 | 70 |

P. and O. Fluidity Test (ARAMCO 6-C). Original Test Bath at 32 F. (See Fig. 1)

| Preheat | Bath Temperature, deg Fahr | Vacuum, cm Hg | Seconds to Move | Pass ^b | Fail ^c |
|------------------------|----------------------------|---------------|-----------------|-------------------|-------------------|
| None..... | 32 | 20 | 80 | .. | X |
| | 36 | 20 | 80 | .. | X |
| | 40 | 14 | 55 | X | .. |
| 212 F..... | 32 | 14.2 | 55 | X | .. |
| | 32 | 14.4 | 55 | X | .. |
| | 32 | 14.5 | 57 | X | .. |
| S-V Cycle | | | | | |
| 100 ^a | 36 | 12, 14 | 68, 55 | X | .. |
| | 32 | 20, 22 | 98, 83 | .. | X |
| 130 ^a | 40 | 15, 15.2 | 59, 63 | X | .. |
| | 36 | 15, 18 | 73, 67 | .. | X |
| 160 ^a | 32 | 12, 13.4 | 43, 50 | X | .. |
| | 28 | 20, 18 | 89, 65 | .. | X |

^a Heat sample to 240 F cool to 0 F and reheat to stated temperature, for example 100, 130, 160 F.

^b Pass—starts moving within 60 sec at indicated temperature.

^c Fail—fails to move within 60 sec at indicated temperature.

TABLE II.—ACTUAL PUMPABILITY TESTS ON MIDDLE EAST RESIDUAL FUELS.

| Run | Thermal Treatment | Cooling Time, days | Pressure Drop in Line, in. Hg | Time to Pump 5 gal, min | Temperature, deg Fahr | |
|-----------------------------|--|---|-------------------------------|-------------------------|-----------------------|----------------|
| | | | | | Foot Valve | Room ± 5 F |
| MIDDLE EAST VACUUM RESIDIUM | | | | | | |
| No. 1..... | Heat to 220 F, cool until pump stops | 1½ | 23 | 3 | 54 | 50 |
| | | 3 | 23 | 5 | 38 | 25 |
| | | 6 | 23 | 5 | 29 | 20 |
| | | 7 ^a | | | 20 | 16 |
| No. 5..... | Heat to 220 F, cool until pump stops | 2 | 12 | 2 | 52 | 45 |
| | | 3 | 15 | 3 | 41 | 35 |
| | | 4 | 16 | 12 | 29 | 28 |
| | | 5 ^b | 22 | 1 gal in 15 min | 25 | 23 |
| No. 3..... | Heat to 220 F, cool to 0 F, heat to 130 F, cool until pump stops | 3 | 11 | 6 | 60 | 56 |
| | | 4 | 11 | 9½ | 54 | 48 |
| | | 6 | 24 | 7 | 45 | 40 |
| | | 88 | 24 | 5 | 44 | 40 |
| | | 10 ^b | 21 | 20 | 40 | 35 |
| | | Insufficient stock for additional pumping | | | | |
| No. 4..... | Heat to 220 F, cool to 0 F, heat to 130 F, cool to 30 F, and heat until pump pumps | 5 | 10 | Did not pump | 32 | 30 |
| | | 6 | 1 (15-16) | | 40 | 40 |
| | | 8 | 1 | | 48 | 50 |
| | | 10 | 0 | | 58 | 60 |
| | | 12 | 12 | 1 min | 64 | 70 |
| | | | | | | |
| BUNKER C FUEL | | | | | | |
| No. 1..... | 220 F, cool until pump stops | 1½ | 14 | 3 | 50 | 48 |
| | | 3 | 17 | 2 | 42 | 40 |
| | | 5 | 26 | 5 | 30 | 30 |
| | | 7 | 10 | 7 | 30 | 30 |
| | | 8 | 17 | 8 | 22 | 17 |
| | | 9 ^a | | | 18 | 17 |

^a Would not pump at these temperatures.

^b Rate too low for practical pumping.

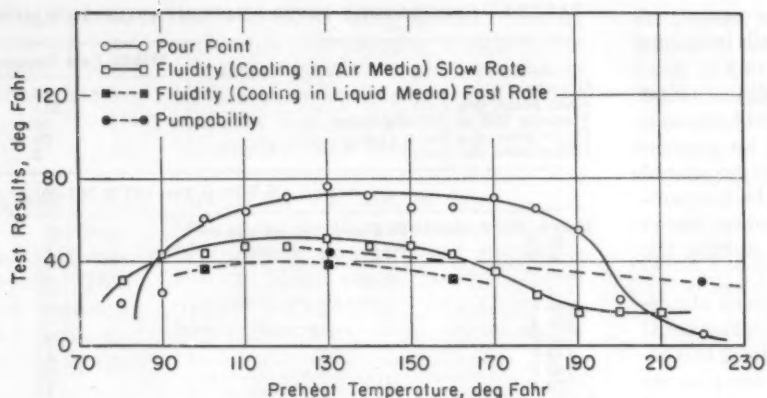


Fig. 3.—Comparison of Pour Point, Fluidity, and Pumpability of Middle East Bunker Fuel Oil.

pumpability temperature and then reheating it to the maximum pour point temperature will not restore the flow characteristics. The lowest pumpability temperature was found in the range of 58 to 64 F, instead of 44 F in run No. 3. From a series of full scale pumpability runs and fluidity tests it was established that a residual fuel oil having a certain minimum pumpability temperature will not become pumpable after cooling below this temperature and reheating to this temperature. It always requires a higher temperature, specific to the stock. The complete elimination of the previous thermal history of the fuel oil to produce a condition of lowest pumpability temperature will require reheating to about 200 to 220 F.

The main conclusions reached in the work partially presented in Tables I and II are as follows:

1. A truly competent test for predicting the pumpability of wax-bearing residual fuel oils must embody the application of adequate shearing rates. Pour point tests are basically unsound for this purpose. They may be accepted only for predicting gravity flow and fluidity at similar low-dynamic head conditions.

2. The heat treatment of the product is of paramount importance. Depending upon the type of thermal history, widely divergent results may be obtained. If the sample is heated to 220 F

and then cooled, the lowest fluidities, pour points, setting points, and pumpability are obtained. If, however, the sample is heated to 220 F and then chilled to nonpumpable conditions and reheated, a critical temperature will be found for every oil at which the pumpability (and the tests indicating the pumpability) is the poorest (in other words, shows the highest temperature). For every oil, conditions of heat treatment may be found which give either the maximum or minimum values for pumpability (and for tests predicting the pumpability). Intermediate conditions of heat treatment will give intermediate results.

3. With this background, it is evident that none of the tests so far offered can give a reliable prediction of the pumpability because the thermal history of the fuel under test is not known and cannot be predicted in future usage. If the seller gives the buyer the value of the "high pour" or any similar value from other tests corresponding to the worst possible heat treatment, this eliminates a fuel which would be satisfactory in all but a few extreme conditions. On the other hand, if "low pour" type of heat treatment is given the sample, then too favorable a prediction of pumpability will be made and complaints are likely to come back.

4. It follows that, no matter which one of the laboratory tests investigated is selected, no test can be developed

without specifying certain mutually agreed upon thermal treatment of the sample.

5. The P. and O. (Aramco 6-C) fluidity test in its present form is an improvement over ASTM D 97 from the standpoint of introducing an appreciable rate of shear. A still further improvement is recommended consisting of the addition of the thermal treatment cycle along the lines of SVM 201-50.

The modified P. and O. fluidity test procedure has been circularized to members of Section D, Research Division VII of ASTM Committee D-2 on Petroleum Products and Lubricants as information.

The prediction of pumpability of wax-bearing residual fuels has already become an important problem in areas of international trade in which Middle East crudes are handled. Now, it is gaining importance on the domestic market, too. The present article has given a correlation of laboratory tests with actual pumpability of fuels aboard commercial ships. The authors hope that their paper will stimulate contributions on the same subject from other researchers who have appraised the existing or newly developed laboratory tests for pumpability from the standpoint of actual field performance of the fuels.

Thixotropy of Lubricating Greases*

A Report from Section IV on Pacific Coast Research of ASTM Technical Committee G on Lubricating Grease of Committee D-2 on Petroleum Products and Lubricants

Prepared by B. W. Hotten¹ and B. B. Farrington¹

SYNOPSIS

A simple worker-penetrometer test has been developed for the measurement of thixotropy of lubricating greases.

Shear softening and age stiffening are measured separately.

The shear-softening rate is measured by the slope of the straight line obtained when penetration is plotted against logarithm of ASTM grease-worker strokes. The age stiffening rate similarly is measured by the slope of the straight line obtained when penetration is plotted against logarithm of aging time after the grease has been worked 3000 strokes.

Typical lithium, sodium, calcium, barium, and aluminum soap greases were measured. A wide variety in magnitude and in extent of reversibility of thixotropic properties was shown among this group of greases. Reproducibility of the test among the section members was good.

The following definition of thixotropy has been selected by Section IV of Technical Committee G of ASTM Committee D-2 as being most suitable for application to lubricating greases:

Thixotropy in lubricating greases is that property which is manifested by a decrease in consistency as a result of shearing, followed by an increase in consistency starting immediately after the shearing is stopped.

Thixotropic shear softening, which increases with shear duration, should be distinguished from the decrease in viscosity which occurs in non-Newtonian, plastic systems with increasing shear rate. The recovery processes should similarly be distinguished: Thixotropic age hardening is a relatively prolonged process, proportional to aging time, whereas the viscosity increase which occurs in plastic systems with decreasing shear rate is instantaneous.

These two phenomena are also distinguishable by their differing degrees of reversibility. Typical lubricating greases vary widely in the extent to which they recover, on aging, the consistency which they had before being worked. The reduction in viscosity which accompanies increasing shear

rate is more uniformly and completely recovered as the shear rate is again decreased, if concurrent thixotropic changes are avoided. A more detailed discussion of the distinction between these phenomena is made by Green (3).²

Despite the distinctions that can be made between thixotropy and plastic flow, it is quite possible that they have similarities in mechanism.

The rigidity of lubricating greases depends upon the network of solid thickener particles which forms when a soap or other thickening agent is dispersed in the oil. Any loss of rigidity which occurs as the result either of shear duration or of increasing shear rate must be a consequence of separation or orientation, or both, of these particles.

Both separation and orientation of such particles have been detected experimentally. Voet (6) showed that the dielectric constant is lower, and thus particle aggregation is greater, in undisturbed dispersions of carbon black and other solid materials than it is in agitated dispersions. Gallay and Puddington (2) have demonstrated particle orientation in flowing greases by examination of them under polarized light. Further studies of these phenomena are needed to improve our knowledge of the rôles which they play in thixotropy as well as in plastic flow.

Aside from its theoretical interest, thixotropy of lubricating grease is of considerable practical importance. Thus, too little or too much shear softening in bearings or poor pumpability resulting from excessive age hardening

may render useless a grease which has otherwise desirable properties.

The major objective of ASTM Technical Committee G, Section IV has been the development of a simple, reproducible quantitative measurement for this important property of greases. This report summarizes the progress which has been made toward this objective since the previous report, prepared by McLennan and Smith (5), was published. This previous report gives general references for the subject of thixotropy and describes in detail a circulating viscometer as a tool for measuring grease thixotropy. The circulating viscometer is a useful research tool, but a cheaper and simpler test was sought for routine measurements. Section IV has since found that the worker-penetrometer test described below is a convenient and potentially useful means of measuring thixotropy.

TEST PROCEDURE

The test developed consists of two parts: first, a series of penetration measurements is made at increasing numbers of worker strokes for determination of the shear-softening rate; then a series of penetration measurements is made on the previously worked sample with increasing aging time for determination of the age-hardening rate.

Shear Softening:

The ASTM grease worker³ was used to provide shearing of varying duration for the grease samples. Two conditions were found to be important to the results obtained in this portion of the test: (a) length of working period and (b) working temperature.

Working periods as long as 100,000 strokes were investigated for a series of thirteen greases. Straight lines were obtained when ASTM penetration was plotted against logarithm of worker strokes for working periods as long as about 20,000 strokes for all thirteen greases. The plots continued as straight lines throughout the whole 100,000 strokes for nine of the greases, but they

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² This paper is contributed by Technical Committee G and is based on the results of cooperative study by Technical Committee G, Section IV, under the chairmanship of B. B. Farrington of the California Research Corp. Other members of the Committee are:

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C. E. Emmons
B. Folds
R. C. Jones

L. Mittleman
L. W. McLennan
H. C. Zweifel

³ The boldface numbers in parentheses refer to the list of references appended to this paper.

³ ASTM Method of Test for Cone Penetration of Lubricating Grease (D 217-52 T), 1952 Book of ASTM Standards, Part 5, p. 119.

curved upward after about 20,000 strokes for the remainder:

| Soap Cation | Number of Greases | |
|-------------------------|---------------------------------------|--|
| | Straight Line through 100,000 Strokes | Curved Line above about 20,000 Strokes |
| Lithium..... | 1 | 1 |
| Sodium..... | 1 | 2 |
| Calcium (hydrated)..... | 3 | 0 |
| Barium..... | 2 | 0 |
| Aluminum..... | 1 | 1 |
| Sodium-Calcium..... | 1 | 0 |
| Total | 9 | 4 |

A working period of 3000 strokes was chosen as one which represents a reasonable amount of agitation and as one which can be completed in a convenient length of time. The 3000-stroke period was considered sufficiently long because periods up to 10,000 to 20,000 strokes did not noticeably change the shapes of work-softening curves obtained on several greases tried and because periods in the range of 50,000 to 100,000 appeared to cause, in some greases examined, a more destructive and permanent type of softening than is usually associated with thixotropy. Penetrations are then taken at 60, 500, and 3000 strokes (three minutes after the worker stops each time) and plotted against logarithm of worker strokes. The slope of the resulting line is taken as a measure of shear softening. The slope figure represents numerically the number of penetration points by which the grease will soften for each tenfold cycle of worker strokes. Shear stiffening, which occurs occasionally, is expressed as a negative slope.

Grease temperature must be controlled during the working process if data are to be obtained under comparable and reproducible conditions.

Because commercially available grease workers have no provision for temperature control, jacketed workers of vari-

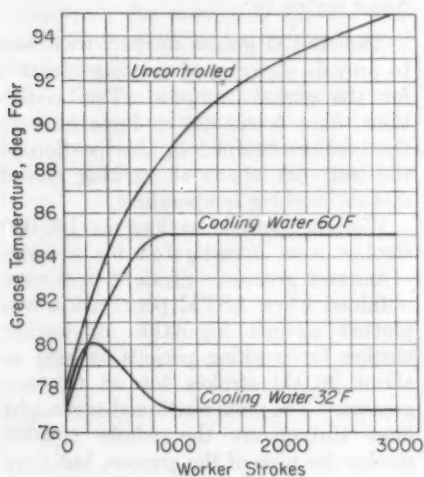


Fig. 1.—Effect on Grease Temperature of Cooling ASTM Worker with Water Through Coils. Aluminum Soap Grease TG-IV-1.

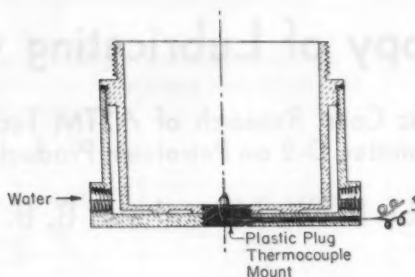


Fig. 2.—Grease Worker Cup with Cooling Jacket and Thermocouple.

ous designs were constructed and tested. A simple cooling device consists of a coil of metal tubing wrapped around a conventional worker for circulation of the cooling liquid. Results obtained with such a device are shown in Fig. 1. Without cooling, the temperature of the aluminum soap grease examined rose to 95 F during 3000 strokes. With tap water at 60 F passing through the coils at about 1 to 2 liters per min the temperature was made to level off at 85 F. Ice water was required to maintain the temperature at the desired 77 F.

A more efficient modification of the grease worker is shown in Fig. 2. The inside dimensions are the same as those of the standard ASTM worker. The inner wall of this worker is thinner than normal, however, as an aid to heat transfer, and it is surrounded by a jacket for the cooling liquid. The jacket shown is threaded and screwed on, but a brazed-on sheet metal jacket is equally effective. An insulated thermocouple mounted in the worker base projects $\frac{1}{4}$ in. up into the worker cup (the plunger is recessed to make room for it). Because of its proximity to the cold worker wall, such a thermocouple does not measure the temperature of the bulk of the sample exactly, but it is within 1 to 3 F of this temperature and is adequate for adjustment of the cooling liquid circulation rate.

Flow of the coolant may be regulated manually or, if desired, automatically. Figure 3 is a diagram of an automatic controlling system. The coolant used was ice water, the valve a General Controls Type K-20-1 solenoid valve, and the controller a Sim-ply-trol controlling pyrometer made by Assembly Products, Inc. In preliminary trials, such a system permitted temperature control to ± 2 F most of the time, but some fluctuations as large as 3 F were noted. It is adequate for routine shear-softening rate determinations, but it would probably be improved if the thermocouple were mounted in the plunger shaft. A surge control valve or manually operated by-pass might also be advantageous.

Age Stiffening:

Because only 8 oz of grease is available from one worked sample, a penetrometer cone smaller than the standard ASTM cone must be used if a series of penetrations of varying aging time is to be obtained. The half-scale cone described by Hotten and Kibler (4) was found to correlate better with the ASTM cone than did other available miniature cones and was therefore used for the age-stiffening rate determinations.

When penetrations obtained with increasing aging time, on grease samples which had been worked 3000 strokes were plotted against logarithms of the aging times, straight lines were obtained. It was found that such plots constructed from penetrations obtained over the period of one week of aging time could generally be extrapolated to predict within about ± 5 points the penetration at the end of one month. The following extrapolated and actual values were obtained on three typical greases:

| | 7-Day Penetration | 28-Day Penetration | |
|----------------------------|-------------------|--------------------|--------|
| | | Extrapolated | Actual |
| No. 1 calcium soap TG-IV-7 | 260 | 252 | 253 |
| No. 2 sodium soap TG-IV-8 | 285 | 279 | 278 |
| No. 3 lithium soap TG-IV-9 | 252 | 249 | 250 |

The following procedure was developed for the age-stiffening rate determination: Immediately after the 3000-stroke penetration is taken, portions of the worked grease are transferred to six Coors No. 0 low form crucibles. The crucibles are stored at 77 ± 2 F. Penetrations are taken in duplicate with the half-scale cone at 1, 24, and 168 (one week) hr aging time. Penetrations are converted to ASTM penetrations according to the relationship:

$$\text{ASTM Penetration} = 1.9 \text{ Half-Scale Penetration} + 17^4$$

and plotted against logarithms of aging times. The slope of the resulting plot is

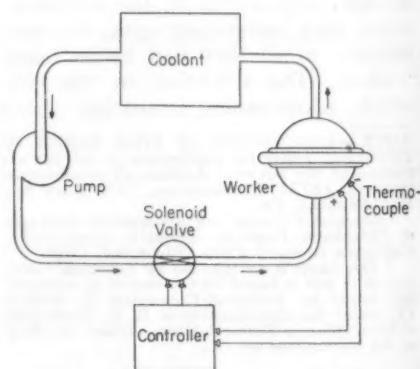


Fig. 3.—Diagram of Automatically Cooled ASTM Grease-Worker Assembly.

TABLE I.—SHEAR-SOFTENING (S)^a AND AGE-STIFFENING (A)^b RATES OF VARIOUS GREASES.

| Grease number.. | TG-IV-1 | | TG-IV-2 | | TG-IV-3 | | TG-IV-4 | | TG-IV-5 | | TG-IV-6 | | TG-IV-7 | | TG-IV-8 | | TG-IV-9 | |
|--------------------------|---------|-----|---------|-----|---------|------|---------|------|---------|------|---------|-------|---------|-------|---------|------|---------|-------|
| | S | A | S | A | S | A | S | A | S | A | S | A | S | A | S | A | S | A |
| Laboratory A... | 6.0 | -15 | 6.5 | -19 | -1.5 | -7 | 18 | -12 | 46 | -4.5 | 3.5 | -9 | -6 | -13 | ... | ... | 42 | -15 |
| Laboratory B... | 9.5 | -21 | 15 | -19 | 0 | -8.0 | 17 | -10 | 48 | -2.5 | 4.0 | -13.0 | -10 | -12 | 22 | -10 | 48 | -18 |
| Laboratory C... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | -10 | -13 | 26 | -6.5 | 44 | -17 |
| Laboratory D... | 4 | -15 | 12 | -28 | 2.5 | -7.5 | 12 | -13 | 45 | -3.5 | 6 | -18 | -6 | -18 | 20 | -11 | 41 | -18 |
| Laboratory E... | 2 | -15 | 7 | -22 | 2 | -7 | 17 | -12 | (22) | -4.0 | (13) | -12 | -2 | -15 | 18 | -11 | 40 | -19 |
| Laboratory F... | 8 | ... | 14 | ... | 5 | ... | 16 | ... | 42 | ... | 7 | ... | -5 | -10 | 28 | -7 | 41 | -20 |
| Laboratory G... | 1.5 | -8 | 11 | -14 | -1.0 | -6.5 | 8.5 | -15 | 43 | -2.5 | 4.0 | -12 | -9 | -12 | 22 | -14 | 44 | -18 |
| Laboratory H... | 7 | -15 | 10 | -17 | 2 | -7 | 19 | -8.5 | 44 | -4.0 | (23.5) | -8.5 | -5 | -15 | 25 | -10 | 37 | -14 |
| Average ^c ... | 5.5 | -15 | 11 | -20 | 1.5 | -7 | 15.5 | -12 | 45 | -3.5 | 5.0 | -12 | -6.5 | -13.5 | 23 | -10 | 42 | -17.5 |
| Average deviation... | 2.5 | 2.2 | 2.5 | 3.5 | 1.8 | 0.3 | 2.9 | 1.6 | 1.7 | 0.7 | 1.3 | 2.3 | 1.8 | 2.8 | 1.8 | 2.4 | 1.5 | 1.5 |
| Standard deviation... | 2.7 | 3.6 | 2.1 | 3.5 | 2.0 | 1.6 | 2.8 | 1.3 | 5.1 | 0.80 | 0.92 | 3.3 | 3.0 | 2.3 | 3.3 | 2.0 | 4.5 | 1.0 |

^a Change in penetration per tenfold working cycle in ASTM grease worker.

^b Change in penetration per tenfold aging cycle after sample has been worked 3000 strokes in ASTM grease worker.

^c Values in parentheses omitted on basis of Dean and Dixon "Q" Test

taken as a measure of age-stiffening rate. The slope was negative in all greases examined, and it represents the decrease in penetration to be expected per tenfold increase in aging time.

The complete thixotropy test should be done in duplicate.

THIXOTROPY OF TYPICAL GREASES

A series of nine typical commercial greases was subjected to the thixotropy test described. Results obtained by the eight cooperating section members are shown in Table I. Compositions and other properties of the test greases are shown in Table II.

Thixotropy Variation with Grease Composition:

Considerable variation in both magnitude and extent of reversibility of shear-softening and age-stiffening rates was observed. Because the test greases differed from one another by more than one preparative variable, it is not possible to draw rigid general conclusions concerning the effect of any one variable. However, the soap cation may be used as a basis for comparing the greases examined. The following dif-

TABLE II.—COMPOSITION AND PROPERTIES OF TEST GREASES.

| Grease number.... | TG-IV-1 | TG-IV-2 | TG-IV-3 | TG-IV-4 | TG-IV-5 | TG-IV-6 | TG-IV-7 | TG-IV-8 | TG-IV-9 |
|-----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Soap: | | | | | | | | | |
| Cation..... | Al | Ba | Ca | Li | Na | Na-Ca | Ca | Na | Li |
| Concentration, per cent..... | 7.8 | 17.2 | 13.2 | 19.0 | 14.5 | 16.9 | 10 | 17.5 | 12 |
| Oil: | | | | | | | | | |
| Viscosity, SSU, 100 F..... | 2465 | 460 | 975 | 70.7 | 305 | 318 | 300 | 1102 | 1175 |
| Viscosity, SSU, 210 F..... | 93.5 | 56.5 | 66.5 | 37.4 | 50.8 | 52.3 | 46 | 80.5 | 72 |
| Viscosity Index..... | -10 | 67 | 12 | 144 | 80 | 88 | 0 | 64 | 15 |
| Pour Point, F..... | 40 | 40 | -10 | -90 | 15 | 20 | 0 | 0 | 0 |
| Water, per cent..... | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 |
| ASTM worker penetration..... | 293 | 306 | 300 | 288 | 289 | 291 | 325 | 275 | 234 |
| ASTM dropping point, deg Fahr.... | 223 | 400+ | 210 | 384 | 360 | 347 | 200 | 360 | 390 |

ferences in behavior among these greases were observed.

The aluminum soap grease, TG-IV-1, has a low shear-softening rate and a medium age-stiffening rate. Calcium soap grease TG-IV-3 has a low shear-softening rate and also a low age-hardening rate, but calcium soap grease TG-IV-7 stiffens on shearing and continues to stiffen at a medium rate on aging. Shear stiffening of this type is probably due to the breaking up of small bundles of soap fibers so that their thickening power is improved. One of the lithium soap greases, TG-IV-4, is medium in respect to both of these rates, but the other, TG-IV-9, has a very high, only partially reversible, shear-softening rate. The sodium soap greases, TG-IV-5 and 8, show medium

to high shear-softening and moderate age-stiffening rates; and, finally, the mixed sodium-calcium soap grease TG-IV-6 has a lower shear-softening rate but a higher age-stiffening rate than either of the pure sodium soap greases.

Examples of typical thixotropy plots by individual laboratories for two of these greases are shown as Fig. 4 and 5.

Reproducibility:

The reproducibility of the values obtained is considered good, when the number of variables present in the test is taken into account. The average deviation among the cooperating laboratories for the shearing slope varies from 1.3 to 2.9 for individual greases and is 2.3 for all the greases taken as a group.

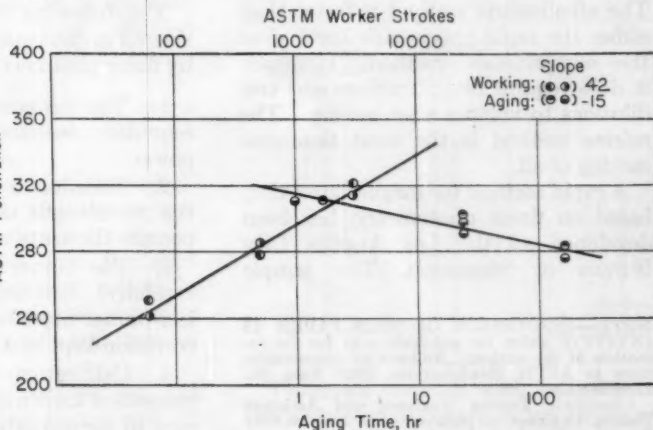
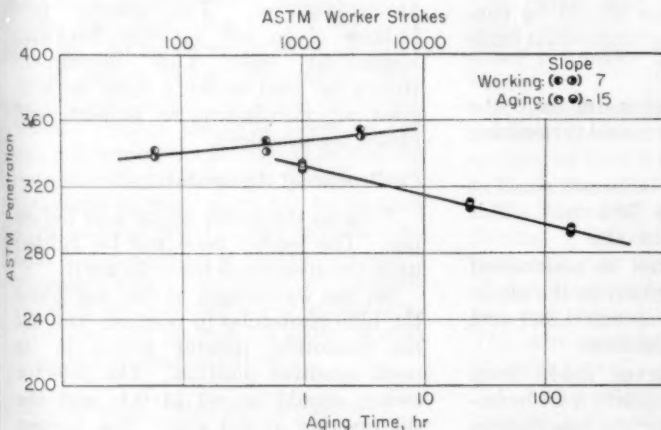


Fig. 4.—Thixotropy of Aluminum Soap Grease TG-IV-1, in Duplicate.

Fig. 5.—Thixotropy of Lithium Soap Grease TG-IV-9, Duplicate Tests.

For the aging slope it varies from 0.3 to 3.5 for individual greases and is 1.7 for all the greases. Standard deviations are also given in Table I. The standard deviation for the shearing slope varies from 0.92 to 5.1 for individual greases and is 2.8 for all the greases. For the aging slope it varies from 0.8 to 3.6 for individual greases and is 2.6 for all the greases.

Three of the shear-softening values were eliminated as extraneous on the basis of the Dean and Dixon "Q Test" (1) before calculation of these reproducibility estimates.

No attempt was made to correlate the values obtained with functional properties of the greases. Such correlations will probably prove to be specific for particular applications, rather than general.

CONCLUSIONS

1. The plot of ASTM penetration against logarithm of strokes in the

ASTM grease worker is linear, at least up to 20,000 strokes, for typical commercial greases. The slope of such a plot obtained for a working period of 3000 strokes at $77 \pm 2^\circ\text{F}$ serves as a convenient measure of shear-softening rate of a grease.

2. Similarly the plot of ASTM penetration against logarithm of aging time after working is generally linear, at least over a period of one month. The slope of such a plot obtained for grease samples aged over a period of one week at $77 \pm 2^\circ\text{F}$ after being worked 3000 strokes serves as a convenient measure of age-stiffening rate.

3. Considerable variation in rates of shear softening and age stiffening is shown as grease composition is varied. Among the moderate number of greases examined, hydrated calcium soap greases had the lowest shear-softening rates and lithium and sodium soap greases the highest. No general relationship between soap cation and age-stiffening rate could be detected in this series.

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Flame Photometric Determination of Magnesium Oxide in Portland Cement

By T. C. Wilson¹ and N. J. Krotinger¹

THE three alternate methods in ASTM Methods C 114 - 47² for the determination of magnesium oxide in portland cement are time consuming. The rapid gravimetric method requires the removal of silicon dioxide, aluminum and ferric oxides, and calcium oxide. In addition, the magnesium ammonium phosphate precipitate must stand for at least 8 hr. The alkalimetric method is faster than either the rapid gravimetric method or the oxyquinolate method. However, it does require two filtrations and two dilutions to volume after boiling. The referee method is the most time-consuming of all.

A rapid method for magnesium oxide, based on flame photometry, has been developed at the Los Angeles City Bureau of Standards. The sample

solution used for magnesium oxide may also be used for the determination of sodium and potassium oxides by flame photometry and sulfur trioxide by nephelometry. After solution of the cement sample and before analyzing for other constituents, insoluble matter must be filtered off. This residue may be used for the determination of insoluble residue.

The following items should be considered in determining magnesium oxide by flame photometry:

1. The instrument must have the requisite sensitivity and resolving power.

2. Emission is in a broad band at the wavelength used (383 mμ). This permits the use of a wide slit.

3. The burner must be maintained carefully. Salt deposition on the atomizer-burner must be prevented and acid corrosion kept to a minimum.

4. Calibration curves made from cements of known composition are necessary to compensate for the interference of the other chemical constituents of portland cement.

The instrument used at the Los Angeles City Bureau of Standards is the Beckman Model DU Flame Spectrophotometer operated on acetylene and oxygen. Use of hydrogen as a fuel or the substitution of a photomultiplier tube for the regular phototube may increase the sensitivity. However, the limiting factors are the operating characteristics and the maintenance of the atomizer-burner. The specific procedures given are for the Beckman instrument only. This instrument should be used under a hood or with good air circulation, as irritant acid fumes are produced.

Calibration of Apparatus:

Turn on the power about 1 hr before use. The burner need not be lighted until the operator is ready to use it.

Set the wavelength at 383 mμ, place the blue phototube in position, and set the phototube resistor switch in its most sensitive position. The selector switch should be set at 0.1, and the slit opening at 0.3 mm. The oxygen and acetylene are turned on. The oxygen pressure is specified for each

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² Standard Methods of Chemical Analysis of Portland Cement (C 114 - 47), 1952 Book of ASTM Standards, Part 3, p. 62.

burner at the factory. The acetylene pressure is set between 3 to 5 psi as determined by the best flame conditions. Cements containing from 1.5 to 6.0 per cent magnesium oxide are dissolved and made up to volume as described under Procedure. Select a cement with an MgO content near to 5.0 per cent as a standard cement. When the standard cement solution is atomized in the burner, the sensitivity control should be adjusted to give a transmittance of 100 per cent on the scale. If a suitable spread of cements is not available, a cement with a low magnesium oxide content can be adjusted with increments of a magnesium salt to give the desired spread. This is best done when making up to volume after solution of the cement.

After zeroing out the dark current, atomize the standard cement solution with the transmittance scale set at 100 per cent. Open the shutter and zero the null meter with the sensitivity control. Immediately atomize another cement solution, rotating the transmittance knob to again zero the null meter. Read the per cent transmittance. Atomize the standard cement solution and note if 100 per cent scale transmittance zeroes the null meter. If so, record the reading. Otherwise repeat the whole procedure. Spray distilled water after each reading, closing the shutter at the same time.

The remaining cement solutions are treated in a like manner. A calibration curve is plotted with per cent transmittance on scale against per cent magnesium oxide (Fig. 1). The actual transmittance is 0.1 of the scale reading. Different burners give slightly different calibration curves.

Procedure:

Weigh 2.5000 g of cement into a 400-ml beaker. Add 25 ml of distilled water; swirl. Add 25 ml of 1:1 HCl. Break up any lumps with the flattened end of a stirring rod. Add 75 ml of water and digest for 15 min short of boiling. Filter through a rapid filter paper into a 250-ml volumetric flask, and wash paper six times with hot water. Retain the filter paper in the original beaker for the insoluble residue determination. Cool the flask to room temperature and make up to volume with distilled water. The sample solution under analysis is atomized in comparison with the standard cement solution as described under calibration. The per cent magnesium oxide is read from the calibration curve.

Maintenance of the Atomizer-Burner:

The limiting factor in this determination is the flame stability. Due to the

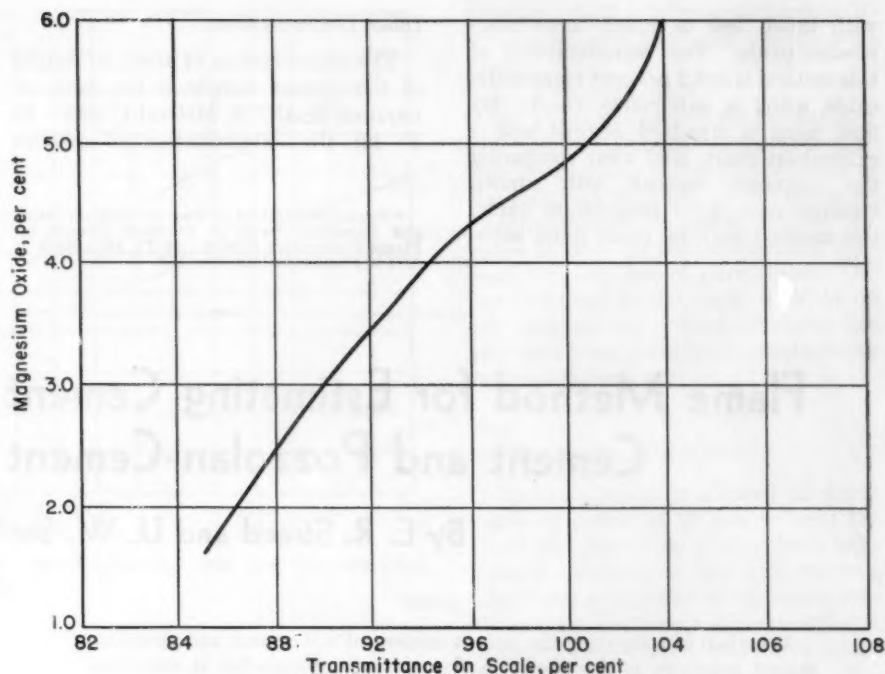


Fig. 1.—Magnesium Oxide in Portland Cement

Slit—0.3 mm
Selector Switch—0.1

Blue Phototube
Wavelength—383 mμ

deposition of the acid-soluble constituents of cement on the atomizer-burner, great care must be used in maintaining a stable condition. Operators should learn to recognize a desirable flame as outlined in the Beckman manual for this instrument. Any abnormal conditions should be immediately corrected. Two or more burners should be on hand if the instrument is to be used constantly. The following preventive maintenance should be practiced:

1. Only clear solutions are atomized. The standard cement solution should be checked frequently for dirt, etc., as it is stored for a longer time than routine samples.

2. After each separate magnesium oxide determination, some distilled water is sprayed through the atomizer-burner.

3. After completion of a dozen cement analyses, distilled water is sprayed at least 5 min.

4. If there is a stoppage, the acetylene is turned off and, with the oxygen flowing, a thin wire supplied with the instrument is inserted into the inlet of the atomizer-burner and moved in and out several times with rotation. This wire must be smooth and have no burrs or kinks.

5. Any adhering deposits on the outside of the atomizer-burner and on the palladium tip should be scraped off, using a fingernail.

Experimental Data:

Five cement samples were analyzed by the standard gravimetric method and by flame photometry. These analyses were made with great care.

| Flame Photometry Magnesium Oxide, per cent | Gravimetric Magnesium Oxide, per cent | Difference, per cent |
|--|---------------------------------------|----------------------|
| 4.06..... | 4.15 | -0.09 |
| 4.70..... | 4.79 | -0.09 |
| 4.34..... | 4.27 | +0.07 |
| 1.82..... | 1.83 | -0.01 |
| 4.10..... | 3.95 | +0.15 |
| | | Avg. 0.08 |

Twelve routine cement samples were analyzed by both methods with ordinary care. Results are reported to 0.1 per cent.

| Flame Photometry Magnesium Oxide, per cent | Gravimetric Magnesium Oxide, per cent | Difference, per cent |
|--|---------------------------------------|----------------------|
| 4.6..... | 4.5 | +0.1 |
| 4.4..... | 4.1 | +0.3 |
| 4.3..... | 4.0 | +0.3 |
| 4.1..... | 4.0 | +0.1 |
| 4.5..... | 4.4 | +0.1 |
| 4.5..... | 4.2 | +0.3 |
| 4.6..... | 4.8 | -0.2 |
| 4.7..... | 4.7 | 0.0 |
| 4.2..... | 3.9 | +0.3 |
| 4.6..... | 4.5 | +0.1 |
| 4.3..... | 4.3 | 0.0 |
| 4.4..... | 4.3 | +0.1 |
| | | Avg. +0.2 |

Unknown cements with magnesium oxide content near that of the standard cement can be analyzed with a better accuracy than an unknown cement

with much less or much more magnesium oxide. The reproducibility of this method is ± 0.2 per cent magnesium oxide using a calibration chart. By first using a standard cement and a calibration chart, and then comparing the unknown cement with known cements near it in magnesium oxide, this method may be made more accurate.

Other Determinations:

The concentration of acid and weight of the cement sample is the same as required in ASTM Method C 228 - 49 T³ for the determination of alkalies

³ Tentative Method of Test for Sodium Oxide and Potassium Oxide in Portland Cement by Flame Photometry (C 228 - 49 T), 1952 Book of ASTM Standards, Part 3, p. 158.

by flame photometry. Sodium and potassium oxides are determined on a portion of the solution in the volumetric flask.

Insoluble residue is determined on the residue retained on the filter paper and in the original beaker.

Sulfur trioxide is determined on a 100-ml portion of the solution.

Flame Method for Estimating Cement Content of Soil-Cement and Pozzolan-Cement Mixtures

By E. R. Streed and U. W. Stoll¹

SYNOPSIS

A method of estimating the cement content of soil-cement and pozzolan-cement mixtures is described. A flame spectrophotometer is employed to determine the calcium concentration from which the cement content is estimated.

A preliminary evaluation indicates that the method is a simple rapid means of checking the cement content of plant-blended pozzolan-cement mixtures as well as that of soil-cement field mixes.

THE recent interest shown in determining the cement content of soil-cement and pozzolan-cement mixtures indicates the need for a rapid yet adequate method for such an analysis (1, 2)². The method described below is similar to others serving the same purpose in that the acid-soluble calcium provides the basis on which the cement content is determined. It differs in that the calcium concentration is found by the flame photometer and preparatory steps are much shorter and simpler than those required for the conventional chemical procedures. Because the spectrophotometer has become a basic instrument in most laboratories and the extension of its use to flame photometric analysis is relatively inexpensive, it is felt that the method to be described can be extensively applied.

INSTRUMENTATION

The instrument employed in this study was a Beckman flame spectrophotometer consisting of a Model DU spectrophotometer and a Model 9200 flame attachment. The necessary auxiliary equipment for atomization and excitation is provided by the manufac-

turer. Suitable gases (hydrogen or acetylene and oxygen) must be available at regulated pressures. The general procedure in performing the experimental manipulations necessary to measure spectral intensities has been technically described in literature provided by the manufacturer and others (3, 4, 5). A brief discussion of the application of flame photometric procedures to cement mixtures is given below.

DISCUSSION

Although flame emission methods have been utilized for some time (6) there are certain inherent limitations which must be recognized before applying the method to a particular problem. Careful investigation should be made of interference phenomena resulting from the presence of ions or molecules foreign to the element under analysis. This influence, combined with the possibility of self-absorption, necessitates the use of solutions as dilute as practical. Several studies of these effects have been reported in the literature (7, 8, 9, 10, 15) and various schemes, such as internal standards (8), buffer solutions (11), and the absolute method (10, 12, 13), have been used to compensate for these difficulties.

The flame excitation of an alkaline-earth element such as calcium produces spectra composed principally of diatomic or molecular band spectra (14). It is generally agreed that the possible in-

fluence of the anion associated with the calcium is greater than if the element emitted a line spectra, and therefore the absolute method is most suitable for calcium analysis. This method consists primarily of preparing standard solutions containing approximately the same amounts of the individual constituents as are in the unknown. This method is readily adaptable to soil-cement mixtures as samples of the components are usually available before mixing.

Flame variations can be reduced by accurate control of fuel and oxygen pressures and the use of narrow band slit widths. The manufacturer claims that an analytical accuracy of 0.2 per cent is obtainable with proper conditions. The choice of fuel, gas pressures, slit, and wavelength is not only interdependent but varies with the element under investigation and the characteristics of the particular instrument used.

A preliminary study of these factors was undertaken to determine optimum conditions for cement mixture analysis. Equal amounts of cement were dissolved in HNO₃, HCl, and H₂SO₄ as described under Preparation of Stock Solutions and the spectral emission was measured at various wavelengths. Maximum consistency and sensitivity were recorded for HCl and HNO₃ and further treatment indicated that the emission varied only slightly with increased amounts of acid. The 554 m μ band was found to be the most suitable due to the low flame background; however, the calcium emission is easily detectable at 624 and 423 m μ . Initially, hydrogen was used as the fuel, principally because of its low flame background. Pozzolan-cement mixtures were also analyzed using acetylene which produced a comparable band to background

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² The boldface numbers in parentheses refer to the list of references appended to this paper.

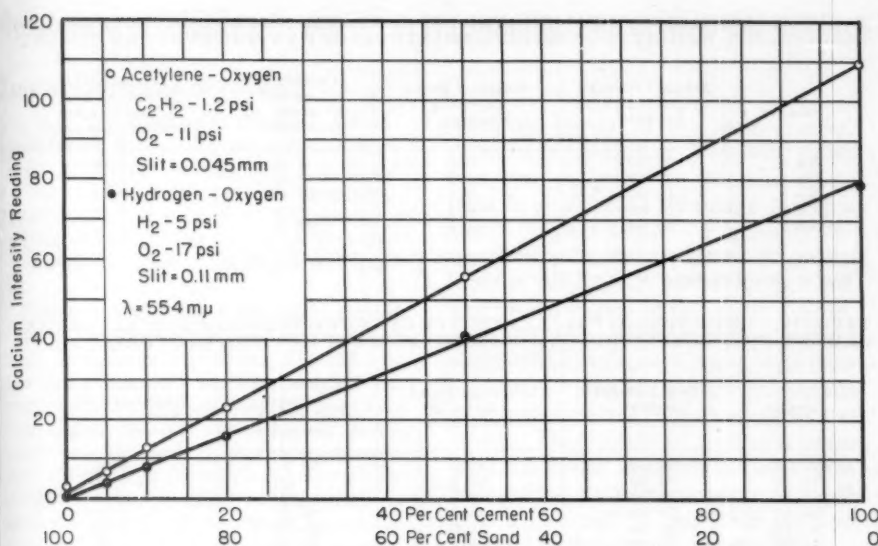


Fig. 1—Plot of Calcium Intensity Readings to Show Linearity over the Concentration Used.

ratio. Either gas was found to give acceptable results but acetylene may be preferred because of its availability and ease of handling. Various oxygen and fuel pressures were used to determine the optimum pressures for maximum band to background ratio. These pressures were 11 psi O₂ (with 1.2 psi C₂H₂), and 17 psi O₂ (with 5 psi H₂) for the particular apparatus used. Slit widths of 0.14 mm for H₂ and 0.05 mm for C₂H₂ were sufficient to give a reading of 100 on the transmission scale, using the stock solutions of 100 per cent cement and the 0.1 sensitivity position. Slit widths up to 0.2 mm are generally employed for calcium emission. However, the nominal band width should be such that a plot of band intensity values *versus* concentration is a straight line over the concentration range used. Such a plot is shown in Fig. 1 for the calcium emission of soil-cement.

TEST PROCEDURE

Preparation of Stock Solutions:

The pure cement, the raw soil or pozzolan, and the soil-cement or pozzolan-cement mixtures are sampled and treated for tests as outlined in ASTM Method 806-47,³ Sections 4 to 5b. The following steps are then taken:

1. Soil-cement

(a) Transfer the contents of each beaker into separate 1000-ml graduates, policing the beakers with a stream of hot water. Using the same beakers, fill the graduates to the 1000-ml mark with cold distilled H₂O. Agitate the contents for 15 sec. Filter approximately 100 ml of the pure cement solu-

tion through a No. 4 Whatman paper into a clean beaker.

(b) In the case of the soil-cement and raw soil solutions, 50-ml aliquots are pipetted from the 1000-ml graduates and diluted to 250 ml in appropriate volumetric flasks. The contents of each flask are thoroughly agitated. Filter approximately 100 ml of the raw soil solution from the flask into a clean beaker. 25 ml of the soil-cement solution are filtered directly from the flask into a glass-stoppered bottle.

(c) By means of volumetric proportioning, prepare 25-ml samples from the filtered stock solutions, bracketing the anticipated range of cement content of the unknown (that is, an 80 per cent soil—20 per cent cement equivalent

solution would require a mixture of 20 ml raw soil and 5 ml pure cement solutions).

2. Pozzolan-cement

(a) Prepare several pure cement and raw pozzolan samples (proportioned by weight) covering the probable range of the unknown mixture; if the unknown pozzolan-cement mixtures fall in the range of 60 to 80 per cent cement, prepare dry mixtures of pure cement and raw pozzolan in the range of 50 to 90 per cent cement. Stock solutions are prepared from the individual samples as outlined in Section 1.

Analysis of Stock Solutions:

The instrument is allowed to warm up for a period of 30 min or until the check position of the selector knob indicates no drifting of the dark current. The flame is adjusted to optimum conditions as previously determined. A portion of each stock solution is transferred to clean 5-ml beakers. The sample containing the greatest cement content is introduced to the atomizer-burner and the wavelength dial is manipulated to give maximum intensity in the 554 mμ region. The dark current is adjusted to give a reading of 100 on the transmission scale with the 0.1 sensitivity knob in position. There is no further manipulation of the instrument settings except for the transmission dial and the dark current zero position. Successive readings are taken on the stock solutions with an intermediate check on the dark current between each sample. In some instances it may be necessary to rinse the capillary with distilled water between samples; however, when testing successive samples of

TABLE I.—DEVIATION OF CALCULATED PER CENT CEMENT FROM ACTUAL PER CENT CEMENT (VOLUMETRICALLY PROPORTIONED RAW SOIL AND PURE CEMENT SOLUTIONS).

| Sample | Actual Cement Content, per cent | Calcium Band Intensity Reading, y | Calculated Cement Content, x , per cent | Deviation of Calculated from Actual Cement Content, per cent |
|-----------|---------------------------------|-------------------------------------|---|--|
| No. 1a... | 50.00 | 51.1 | 49.90 | -0.10 |
| No. 1b... | 25.00 | 26.0 | 25.00 | 0.00 |
| No. 1c... | 12.50 | 13.4 | 12.50 | 0.00 |
| No. 1d... | 6.25 | 7.2 | 6.35 | +0.10 |
| No. 1e... | 0.00 | 0.8 | 0.00 | 0.00 |

Best straight-line formula: $y = 1.008x + 0.8$.

TABLE II.—DEVIATION OF CALCULATED PER CENT CEMENT FROM ACTUAL PER CENT CEMENT (VOLUMETRICALLY PROPORTIONED POZZOLAN AND PURE CEMENT SOLUTIONS).

| Sample | Actual Cement Content, per cent | Calcium Band Intensity Reading, y | Calculated Cement Content, x , per cent | Deviation of Calculated from Actual Cement Content, per cent |
|-----------|---------------------------------|-------------------------------------|---|--|
| No. 2a... | 100.00 | 99.9 | 100.00 | 0.00 |
| No. 2b... | 80.00 | 79.4 | 79.92 | -0.08 |
| No. 2c... | 60.00 | 59.1 | 60.04 | +0.04 |
| No. 2d... | 40.00 | 39.3 | 40.65 | +0.65 |
| No. 2e... | 20.00 | 18.2 | 19.98 | -0.02 |

Best straight-line formula: $y = 1.021x - 2.2$.

³ Method of Test for Cement Content of Soil-Cement Mixtures (D 806-47), 1952 Book of ASTM Standards, Part 3, p. 1464.

approximately the same composition this was not found to be required. The usual difficulties of clogging, so prevalent in previous atomizers, were not apparent at the concentrations used.

TEST RESULTS

A group of exploratory tests were performed using portland cement, a typical sand, and pozzolan⁴ to ascertain the accuracy of the method. A plot of the calcium 554 mμ band intensity readings versus per cent cement content was made for various related samples and the best straight line drawn through these points. The line was expressed in the slope intercept form ($y = mx + a$), where y = calcium band intensity reading, and x = per cent cement content. The calcium band intensity reading was then substituted in the formula and a calculated per cent cement content was obtained. Table I shows the deviation of calculated cement content from actual cement content for several volumetrically proportioned samples prepared from pure cement and raw soil stock solutions.

Table II shows the deviation when using cement and pozzolan solutions. Table III shows the deviation of calculated cement content for several known dry-weight mixtures of pure cement and raw soil. Table IV is the same as Table III except that the relationship is for pure cement and raw pozzolan dry-weight mixtures.

The calcium band intensity readings for four separately prepared pure cement solutions were determined although not shown in the tables. The individual readings were found to vary ± 3 per cent from the average intensity reading for the four samples; on the basis of 100 per cent cement = 100 calcium band intensity reading, the calculated cement content in turn varied ± 3 per cent although extreme care was exercised in preparing the solutions.

DISCUSSION

The test results indicate that small deviations in the calculated cement content occurred in analyzing volumetrically proportioned samples prepared from pure cement and raw soil or pozzolan stock solutions and that larger deviations occurred for separately prepared dry weight mixtures of the same types of materials. It is concluded that the large deviations of the calculated cement content based on the calcium band intensity readings were not wholly due to fluctuations inherent in the detecting method. Rather, a variation in the calcium content of separately pre-

⁴ San Nicholas Island sand and Napa pozzolan.

TABLE III—DEVIATION OF CALCULATED PER CENT CEMENT FROM ACTUAL PER CENT CEMENT (DRY-WEIGHT PROPORTIONED MIXTURES OF RAW SOIL AND PURE CEMENT).

| Sample | Actual Cement Content, per cent | Calcium Band Intensity Reading, y | Calculated Cement Content, x , per cent | Deviation of Calculated from Actual Cement Content, per cent |
|----------|---------------------------------|-------------------------------------|---|--|
| No. 3... | 0.00 | 0.8 | 0.00 | 0.00 |
| No. 4... | 5.00 | 4.8 | 4.99 | -0.01 |
| No. 5... | 10.00 | 8.9 | 10.10 | +0.10 |
| No. 6... | 10.00 | 8.5 | 9.60 | -0.30 |
| No. 7... | 20.00 | 17.1 | 20.32 | +0.32 |

Best straight-line formula: $y = 0.802x + 0.8$.

TABLE IV.—DEVIATION OF CALCULATED PER CENT CEMENT FROM ACTUAL PER CENT CEMENT (DRY-WEIGHT PROPORTIONED MIXTURES OF RAW SOIL AND PURE CEMENT).

| Sample | Actual Cement Content, per cent | Calcium Band Intensity Reading, y | Calculated Cement Content, x , per cent | Deviation of Calculated from Actual Cement Content, per cent |
|-----------|---------------------------------|-------------------------------------|---|--|
| No. 8... | 90.00 | 83.5 | 89.91 | -0.09 |
| No. 9... | 90.00 | 85.9 | 91.58 | +1.58 |
| No. 10... | 70.00 | 66.0 | 70.89 | +0.89 |
| No. 11... | 70.00 | 65.5 | 70.37 | +0.37 |
| No. 12... | 50.00 | 45.0 | 49.06 | -0.94 |
| No. 13... | 50.00 | 45.6 | 49.69 | -0.31 |
| No. 14... | 20.00 | 17.0 | 19.96 | -0.04 |

Best straight-line formula: $y = 0.962x - 2.2$.

pared solutions may account for the major part of the deviations.

From the foregoing discussion one would expect that the deviations of absolute calcium band intensity readings, and their related calculated cement content deviations, would diminish as the absolute cement content (and thus calcium content) of the solutions became smaller. A comparison of Table IV (high cement content samples) with Table III (low cement content samples) shows this to be the case.

CONCLUSIONS

1. The accuracy of any method which relates the cement content of the unknown mixtures to calcium concentrations is dependent partly on: (a) the consistency of calcium concentration of dry constituents, and (b) the adequacy of dissolving techniques.
2. The work described in this paper indicates that the precision of the flame-detecting method is sufficient in view of the considerations listed above.
3. The procedure described is considerably faster than presently employed techniques and could be easily adopted by many laboratories.
4. It appears that the flame-detecting method could be extended to estimate the cement content of hardened concretes and mortars.

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Tensile Properties of Nickel

A STUDY of the effect of temperature on the tensile properties of high purity nickel has recently been completed by the National Bureau of Standards. Tension tests were made at temperatures ranging from -320 to 1500 F on annealed specimens of nickel of 99.85 per cent purity.

Two series of tests were made in this study. The first series was made in the range from room temperature to 1500 F. Specimens were 6½ in. long, with 2-in.-long reduced sections of 0.505 in. diameter. Each specimen was heated and maintained at the desired test temperature, then tested in a hydraulic-type machine (15,000-lb range). The testing machine applied tension to the specimen, producing extension at a controlled rate of about 1 per cent per min. The movement of the head and the tension applied to the specimen were recorded by means of an automatic stress-strain recorder.

The second series of tests was made at temperatures ranging from -320 to +212 F. Specimens were essentially the same as those used in the first series, but the procedure had to be modified to permit them to be fully immersed in a liquid bath during the testing in tension. Loading was controlled to produce contraction of the smallest section of the specimen at a rate of approximately 1 per cent reduction of area per min. A special reduction-of-area gage measured the change in minimum diameter of the specimen during testing.

In both series of tests, specimens were extended to the point of fracture. Fractured specimens were examined metallographically and tested for hardness.

This study showed that in general the metal's yield and tensile strengths and also the ductility at maximum load, tend to decrease with increase in temperature. The elongation at complete fracture attains a minimum at about 500 F. However, irregularities appear in the usual trends of some of the tensile properties in the temperature ranges of about 80 to 300 F and 500 to 700 F. Strain aging apparently occurs in the range 80 to 300 F, and Curie point behavior in the range 500 to 700 F, while recovery and recrystallization predominate at temperatures of 1200 to 1500 F.

Impact Resistance of Concrete

THE NATIONAL BUREAU OF STANDARDS, in cooperation with the Navy Bureau of Yards and Docks, is making an extensive study of the properties of concrete under impact. In results so far obtained, the dynamic compressive strength of concrete was found to be up to 84 per cent higher than the static strength and the modulus of

elasticity up to 47 per cent greater.

In the investigation, 3 by 6-in. cylinders were subjected to standard static tests in a 60,000-lb hydraulic machine and to impact tests in a specially designed drop-hammer machine at various rates of loading up to 10 in. per sec. The total duration of the impact corresponding to the latter rate of loading was 0.0003 sec. "Softer" impact tests having a duration of about 1 sec were made in a hydraulic machine running at full speed. Two types of concrete were used: a "weak" concrete of about 2500-psi nominal static compressive strength and a "strong" concrete of 6500-psi nominal static compressive strength.

The dynamic compressive strength of a given type concrete was found to be higher than the static compressive strength, becoming relatively greater as the duration of impact decreased. The ratio of the dynamic to static strength for the "weak" concrete ranged from 1.09 for a 0.9-sec impact to 1.84 for a 0.00025-sec impact. The corresponding ratio for the strong concretes ranged from 1.13 for the longer impact to 1.85 for a 0.00043-sec impact.

The ratio of dynamic to static modulus increased as the duration of impact decreased, reaching a maximum of 1.47 for the "weak" concrete and 1.33 for the "strong" concrete. The linear portions of the stress-strain curves became longer and steeper as the duration of impact was decreased. The ratio of strain energy absorbed under dynamic loading to that absorbed under static loading reached a maximum of about 2.2 for both concretes tested.

Butyl-Impregnated Leather

THE process for impregnation of leather with natural rubber, which the National Bureau of Standards developed in 1949, has recently been extended to permit the use of polyisobutylene as an impregnant. Soles impregnated with this butyl polymer have the same greatly improved abrasion and water resistance as those containing rubber. However, polyisobutylene has a distinct advantage over rubber as an impregnant in that it eliminates the milling operation required to reduce the molecular size of natural rubber sufficiently to allow deep penetration. It also results in large savings of time, labor, and materials in the tannery.

Impregnation with the butyl compound merely requires soaking of the naturally porous leather in a solution of the polymer. The impregnating solution is prepared by dissolving polyisobutylene, having a molecular weight range between 50,000 and 100,000, in common solvents such as gasoline, kerosine, benzene, or chloroform. The leather is air-dried and immersed in the solution for about three hours. It is then removed from the solution, the excess solvent is wiped off, and the remaining solvent is evaporated from the leather.

Studies have shown that the butyl polymer is well suited for treating shoe soles and upper leather, as it reduces water absorption by about half and doubles abrasion resistance. Service tests were carried out in which the same individual wore one sole of butyl-treated vegetable-tanned crust leather mated with a control sole of untreated leather obtained from the same part of the animal, and finished as commercial sole leather. Cross-mating of these matched soles eliminated any bias due to differences between right and left feet of the test personnel. Of the 12 pairs of soles tested, the control sole wore through before the butyl-impregnated sole in every case. The tests showed that the treatment increases wear by about 80 per cent.

International Association for Bridge and Structural Engineering Annual Papers

THE twelfth volume of "Publications" (1952) of the International Association for Bridge and Structural Engineering contains 17 papers; 8 in English, 4 in French, and 5 in German.

Some of the subjects covered in these papers include: prefabrication in steel-concrete, concrete corrosion, creep and shrinkage losses in prestressed concrete, theories of plasticity and earth pressure, statics of the Vierendeel girder, model verification of the flutter theory, continuous cylindrical beams of prismatic cross-section, and shear center and torsion.

Summaries and titles of all the papers are given in the three languages.


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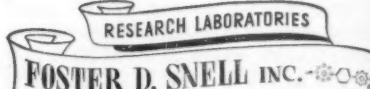
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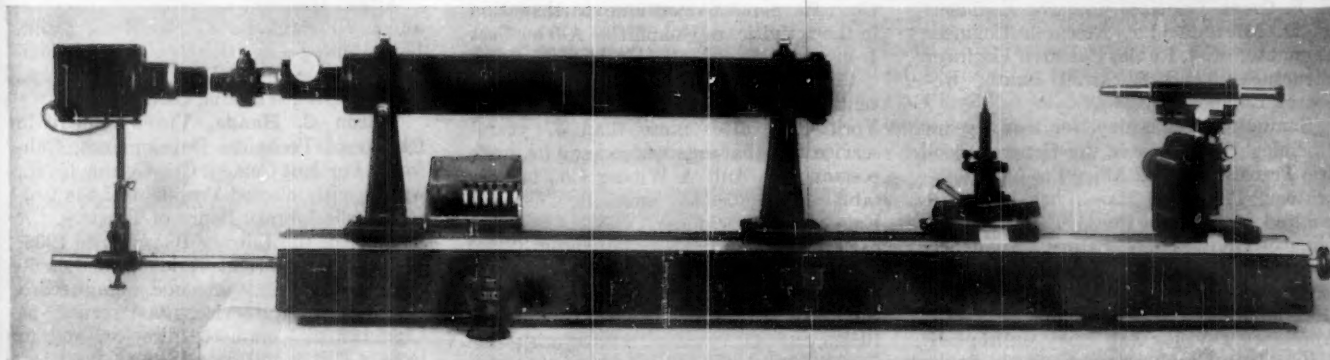
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PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.

At the Spring meeting of the American Chemical Society in Los Angeles the following long-time ASTM members and committee members were among 27 ACS men honored by presentation of 50-year membership certificates: **William Blum**, Consultant, and former Chief of Electrodeposition Section, and Assistant Chief of Chemistry Division, National Bureau of Standards; **Colin G. Fink**, retired Head of Division of Electrochemistry, Columbia University; **Dozier Finley**, Research Consultant, Pabco Products, Inc.; **Chester G. Fisher**, Chairman of Board, Fisher Scientific Co.; and **Harry A. Schwartz**, Manager of Research, National Malleable & Steel Castings Co.

The following members of the Engineering Division research staff of the Association of American Railroads (active also in ASTM work) are among a number of AAR research men who have been assigned new titles, to more clearly identify the specific character of their work in the expanding research program of the Association: **E. E. Cress**, Principal Research Engineer; **P. D. Miesenhelder**, Research Engineer Concrete; **E. J. Ruble**, Research Engineer Structures; and **Rockwell Smith**, Research Engineer Roadway.

Samuel E. Q. Ashley, for many years Chemical Supervisor in the General Electric Transformer and Allied Products Laboratory, Pittsfield, Mass., has been appointed Manager of the G. E. Major Appliance Division Laboratory, Appliance Park, Louisville, Ky. Mr. Ashley will be in charge of directing and expanding a new G.E. laboratory that will serve its Major Appliance Division and carry on applied materials and process research in the fields of chemistry, metallurgy, electricity, and mechanics. A member of many technical groups, and author of numerous papers in the fields of spectrophotometry, analytical chemistry, and chemical education, Mr. Ashley is active in ASTM in Committee E-3 on Chemical Analysis of Metals, serving on its advisory and editorial subgroups, and heading Division G on General Analytical Methods.

James B. Austin, Director of Research and Chief of U. S. Steel Co.'s Research Laboratory at Kearny, N. J., has been appointed Chairman of the Committee on Chemical Warfare, Department of Defense Research and Development Board.

Arnold O. Beckman, President and founder of Beckman Instruments, Inc., South Pasadena, Calif., was one of two men appointed recently to the Board of

Trustees of the California Institute of Technology at Pasadena. An Institute Associate since 1948, Dr. Beckman is the first alumnus elected as trustee. He received his doctorate in chemistry from the Institute in 1928 and served on the faculty from 1929 to 1940, leaving to enter the field of precision instrument manufacturing.

C. W. Blacketer, until recently Technical Director, Industrial Finishes Dept., Atlas Powder Co., Stamford, Conn., is now with Kwal Paints, Inc., Denver, Colo., in a similar capacity.

Hyman Bornstein, associated with Deere and Co., Moline, Ill., for the past 30 years, latterly as Manager of Materials Engineering Department, and Chief Technical Consultant, has retired from active duties. An ASTM affiliate since 1915, Mr. Bornstein has rendered important service on many technical groups through the years, as representative of the Society of Automotive Engineers and American Foundrymen's Association, as well as Deere and Co. He plans to continue participation in the activities of Committee A-3 on Cast Iron and A-7 on Malleable-Iron Castings.

Charles R. Bragdon, who retired recently from Interchemical Corp., New York City, after more than 37 years' service with that organization and its predecessor, The Ault & Wiborg Co., has established an office as Consulting Chemical Engineer in Larchmont, N. Y.

Earl R. Bryant has been appointed Technical Service Director of Universal Atlas Cement Co., New York City, succeeding **Homer G. Farmer**, who retired December, 1952, after 41 years of service with the company.

George D. Calkins, formerly Project Chemist, Bendix Aviation Corp., Detroit, Mich., has been named Assistant Supervisor, Battelle Memorial Institute, Columbus, Ohio.

Bernard W. Culver, until recently with Pace Associates, Chicago, Ill., is now a member of the firm of Hertel, Johnson, Eipper, Stopa & Culver, Architects and Engineers, in the same city.

Gustav Egloff, Director of Research, Universal Oil Products Co., Chicago, is recipient of the 1953 Washington Award of the Western Society of Engineers. The honor is given for "accomplishments which pre-eminently promote the happiness, comfort, and well-being of humanity." Dr. Egloff was cited for "distinguished leadership in petroleum research and development, in professional activities, and in community services."

S. G. Eskin, formerly with the Robertshaw-Fulton Controls Co., Greensburg, Pa., is now Technical Adviser, The Dole Valve Co., Chicago, Ill.

Arno C. Fieldner, Chief Fuels Technologist, U. S. Bureau of Mines, was presented with the second annual Honor Award of the Washington Chapter of the American Institute of Chemists at a dinner at the Roger Smith Hotel in Washington, D. C., on April 7. Associated with the Bureau of Mines since its organization in 1910, Dr. Fieldner during the first World War developed methods for testing the efficiency of gas masks, and subsequently aided in perfecting gas masks for industrial use. Active in developing standard methods and apparatus for analyzing gas and coal, he directed the pioneering work of the ventilation of vehicular tunnels, and has authored more than 400 scientific articles on gas and fuel research. Honorary Member and Past-President of ASTM, Dr. Fieldner has made valued contributions to many phases of the Society's work, heading Committee D-5 on Coal and Coke for 28 years.

Alexander Gobus, formerly Director, Non-Destructive Testing, Sam Tour & Co., Inc., New York City, has accepted a position with the North American Philips Co., Inc., Mt. Vernon, N. Y., as Manager of the Industrial X-Ray Division.

Harrison F. Gonnerman, who retired last year from the Portland Cement Assn., Chicago, Ill., after 25 years' service on the PCA Research and Development Staff, has set up an office in his home in Oak Park, Ill., as Consulting Engineer and Research Consultant.

Arthur Halpern, formerly with the Pasadena Research Labs., Pasadena, Calif., has accepted a position as Chemical Engineer with the Great Lakes Carbon Corp., Dicalite Div., Waveria, Calif.

Wilson C. Hanna, Vice-President in Charge of Technical Development, California Portland Cement Co., Colton, Calif., was recently elected President of the Colton Public Library Board of Trustees. A member of the Library Board since 1935, Mr. Hanna during his residence of over 50 years in Colton has amassed a long record of community service, has served as Chamber of Commerce director, and in Rotary Club and Boy Scout activities. Affiliated with ASTM since 1905, he was elevated to Honorary Membership in 1950, in recognition of his valued contributions in technical and administrative activities of the Society. Recognized as one of the country's leading chemists, Mr. Hanna also has gained recognition as an ornithologist and is said to have one of the largest collections of birds' eggs in this country.

J. A. Hartley recently retired as President of the Braun Corp., Los Angeles.

James J. Haus has accepted a position with the American Wheelabrator and Equipment Corp., Mishawaka, Ind.

Samuel L. Hoyt, Technical Adviser at Battelle Memorial Institute, Columbus, Ohio, has been given the George Kimball Burgess Memorial Award by the Washington, D. C., Chapter of the American Soci-

(Continued on p. 66)

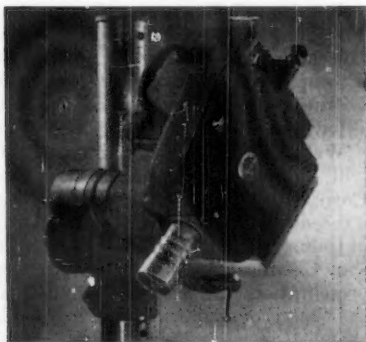
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determining bovine pregnancy... a fast blue-sensitive plate

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As a tool for the engineering analysis of mechanical motions too fast for the eye or even for the sports newsreel type of "slow motion," we make the Kodak High Speed Camera. It can take from 1000 to 3200 full 16mm frames per second and can superimpose the corresponding oscillograph record on the pictures if required. It is simple to operate, and gives pictures of excellent photographic quality. We have sold a very respectable number of them to people who have found its speed range just right for the great majority of mechanical design problems.

Nevertheless, there are problems, mostly in fundamental research, where simplicity, economy of operation, and even image clarity must



be sacrificed for higher repetition rates. Several high speed cameras of such specialized design have appeared in recent years, and we are frank in our admiration of them.

For a reprint of an informative article ("Special Report on High Speed Photography in Design"), for inquiries about the Kodak High Speed Camera, or for help in selecting film or plates for any form of high speed photography, address Industrial Photographic Sales Division, Eastman Kodak Company, Rochester 4, N. Y.

Microradiography

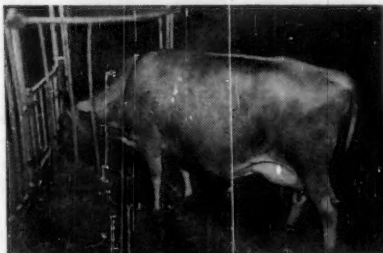
Of the total film acreage that we produce for the finding of voids, fractures, porosities, inclusions, and other defects in man, metal, and beast, an infinitesimal fraction is used in the sub-technique of microradiography. This is in effect two-

stage x-ray photomicrography: a film or plate of high resolution is exposed to x-rays through a thin specimen section and then an optical enlargement is made of the resultant radiographic image. Thus by differential x-ray absorption is revealed the distribution of various elements in the microstructure of the specimen. For accurate identification, it is helpful to employ the line-emission from the tube target, but it is not convenient to keep changing targets in order to find the sets of line-emissions desired. Furthermore the continuous spectrum plays a distracting *obligato* to the nice, clear-cut relations of K-emissions and absorptions.

Unworried by the knowledge of how little the consumption of materials for microradiography contributes to their salaries, a few of our research people have been attacking this problem and have just put out a paper that tells how to use a variety of dependably homogeneous K-radiations from interchangeable x-ray fluorescence targets that you can put in an attachment for your low voltage x-ray tube.

Anyone who wants to make one like it can get a reprint from us of the paper, "Application of Fluorescence X-rays to Metallurgical Microradiography." Write X-ray Division, Eastman Kodak Company, Rochester 4, N. Y.

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From *Country Gentleman* we have recently learned that one of our products is good for spotting pregnant cows. You permit a urine sample from the bossy in question to stand at room temperature, then add a saturated aqueous solution of *Indophenol Sodium Salt*. If green turns out to be the prevailing color note, rejoicing is in order. This

method told the truth 91% of the time in one herd of 136 cows. All we know about it is what we read in *Country Gentleman* (September '52, p. 57).

Indophenol Sodium Salt is just one of over 3500 Eastman Organic Chemicals. For a copy of our catalog, write Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y.



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Kodak Spectroscopic Plates are sold by the Kodak Industrial Dealer in your area. If he has not already been supplying them to you, your note to Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y., will bring full information and get your shipment moving to your dealer.

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are... serving laboratories everywhere

(Continued from p. 64)

ety for Metals, for outstanding work in the field.

Robert W. Hunt Co., Engineers, Chicago, Ill., announces that **H. H. Morgan** has been advanced to President, and **W. J. Bongard** to Vice-President. The remaining officers are **L. H. Stott**, Vice-President; **S. C. Sexauer**, Secretary; and **W. P. Anderson**, Treasurer.

The Hunt Co. has held membership in ASTM since 1899. Mr. Morgan, Past-President and Honorary Member of the Society, and Past-Chairman of Committee A-1 on Steel, has made important contributions in many phases of ASTM work.

Leon Kapelsohn, formerly associated with Hearn's Department Stores, Inc., is now Assistant to the President, Chemical Specialties Co.; Dro, Inc., New York City.

C. B. Karns retired recently as Manager, Esso Standard Oil Co. of Penna., Pittsburgh.

John K. Killmer has been advanced from Metallurgical Engineer to Chief Metallurgist, Bethlehem Steel Co., Bethlehem, Pa.

H. Kirtchik, of the Thomson Laboratory of General Electric Co., Lynn, Mass., has been transferred to the Evendale (Ohio) plant laboratory as leader of the analytical group.

Gordon M. Kline, Physical Science Administrator at the National Bureau of Standards, was presented with the United States Department of Commerce gold medal for exceptional service. He was cited "for major contributions to science and technology through pioneering work and accomplishments in the field of organic plastics and for distinguished authorship." Dr. Kline's first Federal Government service was in 1918 as a messenger for the Honorable Herbert Hoover, Food Administrator during World War I.

M. H. Kraus has accepted a position with Jerrold Electronics Corp., Philadelphia, Pa. He was previously on the technical staff of Eckert Mauchly Computer Corp., of the same city.

John L. Kronau, formerly President, Eastern Highways Corp., Brooklyn, Md., is now President and Treasurer, Patapsco Engineering Co., Inc., Baltimore, Md.

H. McC. Larmour is now associated with the Ideal Cement Co., Redwood City, Calif., as Chief Chemist. Until recently he was on the engineering staff of the Pacific Portland Cement Co., in the same city.

K. J. Mackenzie, for many years Technical Research Manager, International Business Machine Corp., Endicott, N. Y., has been appointed Manager of Engineering Personnel at the Endicott plant.

William E. Mahin, Director of Research at Armour Research Foundation of Illinois Institute of Technology, Chicago, has been reappointed a member of the National Advisory Committee for Aeronautics. A metallurgist, Dr. Mahin serves on the Subcommittee on Aircraft Structural Materials.

Milton Male has been appointed Manager of the Building and Construction Industries Section of United States Steel's Commercial Department, Pittsburgh, Pa.

Mr. Male has been Director of Housing Research in the Company's Research and Technology Division since 1946. His new assignment will include responsibility for coordinating and assisting the technical activities of U. S. Steel's housing subsidiary, Gunnison Homes, Inc.

L. E. Martony, Jr., formerly Chief Engineer, Pioneer Alloy Products Co., Cleveland, Ohio, has accepted an appointment as Project Engineer with Talon, Inc., Meadville, Pa.

M. G. Mellon, Professor of Analytical Chemistry, Purdue University, Lafayette, Ind., is one of three members of the Purdue faculty awarded research grants by Eli Lilly & Co.

D. Y. Miller, Chemical Engineer of Celanese Corp. of America, has been assigned to the Market Development Department of the Textile Division in Charlotte, N. C.

Floyd L. Miller has completed his year's assignment in Washington, D. C., as Vice-Chairman of the Research and Development Board of the Department of Defense, and has returned to Standard Oil Development Co., New York City, as Manager of the Contract, Legal and Patent Department. Prior to his Washington assignment, Dr. Miller was head of Standard Oil Development Co.'s Research Division.

Howard G. Minckler, formerly Asphalt Inspector, J. E. Greiner Co., Baltimore, Md., is now on the staff of Miller-Warden Associates, Civil Engineering Section, Swarthmore, Pa.

Harry E. New has been appointed Technical Sales Representative for The Chemstrand Corp., Decatur, Ala. Mr. New will make his office at Decatur where the firm's manufacturing plant, multi-unit research center, and administration headquarters are located. Mr. New has been associated with American Viscose Corp. for the past 14 years, heading the Cotton Division of the Textile Research Department for four years, and being one of the original group who formed the AVC Textile Research Department in 1939.

Harry E. Outcault retired from St. Joseph Lead Co., New York City, after 22 years of service with the company, recently in the capacity of Manager, Zinc Oxide Sales. Mr. Outcault resides at 37 Woodland Rd., Short Hills, N. J.

James F. Peelle has retired as President of the Richmond Fireproof Door Co., Richmond, Ind. Mr. Peelle has represented his company in the Society since 1931, and has served as a member of Committee E-5 on Fire Tests of Materials and Construction for many years. **R. K. Peelle** will succeed Mr. J. F. Peelle as Company representative in the Society and on Committee E-5.

Edwin B. Powell, Consulting Engineer, Stone & Webster Engineering Corp., Boston, Mass., was one of eight members of the American Society of Mechanical Engineers honored at the ASME Annual Meeting in late 1952 by election to the grade of Fellow of that Society. Mr. Powell has been very active in ASME affairs, especially on Boiler and Power Test

Codes Committees. In ASTM he serves on Committee D-19 on Industrial Water.

Louis F. Rahm, Director of the Plastics Program at Princeton University, has been given an industrial grant by the Polychemicals Div., E. I. du Pont de Nemours and Co., Inc.

William A. Reich, until recently with the General Electric Co., in Schenectady, N. Y., as Head of the Metallurgy Section, Works Lab., has been transferred to the Carbonyl Dept. of G.E. in Detroit, Mich. Mr. Reich has made outstanding contributions in ASTM Committee B-9 on Metal Powders and Metal Powder Products, being one of the organizers of this group, and Chairman of the committee since its organization in 1944 until relinquishment of the duties of this office on transfer to his new G.E. assignment where he is engaged in a "producing" capacity.

Gerald Reinsmith has accepted appointment as Manager of the Washington (D. C.) office of Narmco, Inc. He was previously Materials Engineer, Office Chief of Ordnance, U. S. Army.

T. L. Robinson, formerly associated with The Wel-Met Co., Kent, Ohio, is now President, Powdercraft Corp., Spartanburg, S. C.

Franklyn C. Rogers, until recently with the Bureau of Engineering Research, Rutgers University, New Brunswick, N. J., is now Resident Engineer, Harza Engineering Co., Maithon, Manbhum District, Bihar, India.

Walter A. Schmidt, President and General Manager, Western Precipitation Corp., Los Angeles, Calif., was honored at a recent luncheon meeting of the Division of Industrial and Engineering of the American Chemical Society in Los Angeles by presentation with a scroll commemorating the "many contributions he has made to chemical science, technology, industry, and engineering, and to the chemical profession."

Walter E. Scholer, who heads up American Viscose Corp.'s Fabric Development Dept., was elected President of the American Association of Textile Technologists at its meeting in January in New York. **Erb N. Ditton**, Research Director, Gotham Hosiery, and **Gerald K. Lake**, of Burlington Mills Corp., were elected first and second Vice-Presidents, respectively.

Norman C. Schultze, formerly Head, Technical Service Div., Research and Development Lab., U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp., is now affiliated with Mathieson Chemical Corp., Baltimore, Md.

C. Thompson Stott, for many years Chief Metallurgist at Sparrows Point (Md.) plant of Bethlehem Steel Co., has been made Assistant General Manager of the plant.

Henry Swanson, formerly Asphalt Engineer, Berry Asphalt Co., Chicago, Ill., is now with Spa Products Co., Hot Springs, Ark., in the capacity of Vice-President and Manager.

Robert D. Thompson, until recently Glass Products Engineer, Taylor Instrument Companies, Rochester, N. Y., has been named Division Head, in Charge of

(Continued on p. 68)

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(Continued from p. 66)

Research, Design, Methods and Technical Sales, in the Glass Products Division of the company.

Samuel A. Wenk has been named Supervisor, Non-Destructive Testing Research, Battelle Memorial Institute, Columbus, Ohio. For the past three years Mr. Wenk has been closely associated with research at Battelle aimed at developing new methods for inspecting manufactured goods without destroying them, much of his work being centered on new methods for the detection of flaws in engineering materials. In ASTM Mr. Wenk is serving on Committee E-7 on Non-Destructive Testing.

H. M. Williams recently retired as Vice-President of The National Cash Register Co., Dayton, Ohio. Mr. Williams had

represented his company in the Society since 1940.

Morton O. Withey, Dean of Engineering, University of Wisconsin, Madison, and long-time ASTM member, Honorary Member of Committee C-9 on Concrete, and Past-Officer of the Society, was given an interesting write-up in the Science Section of *Newsweek* of March 2, and pictured with some of his 2500 test concrete cylinders which he has been casting, sampling, and testing since 1910, five years after his graduation from Dartmouth College. The item in *Newsweek* followed announcement by the University of Wisconsin of Dean Withey's forthcoming retirement at the mandatory age of 70, and simultaneous release of a progress report on the research project that has lasted most of his adult life. The castings and an equal

number of smaller blocks have been periodically sampled and tested to see how various proportions of cement, sand, and crushed stone fare with aging under various conditions. Professor Withey plans to stay at Madison after he retires, and continue to take a hand at testing his concrete. He says, "I'd like to arrange with St. Peter to stick around till the research is finished." However, the work will not be completed until 2037, the year the last batch of the 18-inch-high concrete cylinders is 100 years old.

Gordon R. Worthen, formerly Metallurgist, Shenango Agaloy Tube Co., Springfield, Ohio, is now on the Metallurgical Staff of The Steel Products Engineering Co., in the same city.

NEW MEMBERS...

The following 127 members were elected from February 2 to March 18, 1953, making the total membership 7428 ... Welcome to ASTM

Note—Names are arranged alphabetically—company members first then individuals

CHICAGO DISTRICT

Candy & Co., Inc., Gene Abson, Consultant, 2515 W. Thirty-fifth St., Chicago 32, Ill.
Mastic Asphalt Corp., T. F. Harland, Chief Chemist, 131 S. Taylor St., South Bend, Ind.
Buerosse, A. E., Plastic Engineer, Wells Manufacturing Co., Fond du Lac, Wis.
Domke, Frank F., Laboratory Supervisor, Gardner Machine Co., Beloit, Wis. For mail: Box 288, Rockton, Ill.
Griffin, W. F., Superintendent, Receiving Tube Plant, Crosley Division Avco Manufacturing Corp., North Island Ave., Batavia, Ill. For mail: 905 Meadows Rd., Geneva, Ill.
Haasch, John, Chief Inspector, Webster Electric Co., Clark & Dekoven, Racine, Wis.
Isolampi, Frank U., Chief Control Metallurgist, United States Steel Corp., Gary Steel Works, Broadway #1, Gary, Ind.
Kellicutt, Keith Q., Engineer (Packaging), United States Forest Products Lab., Madison, Wis.
Kurtenacker, Robert S., General Engineer (Packaging), United States Forest Products Lab., N. Walnut St., Madison 5, Wis.
Kruger, K. W., Acting Chief, Division of Material Containers, United States Forest Products Lab., Madison 5, Wis.
Longfield, M. H., Metallurgy and Finishing Engineer, Pheoll Manufacturing Co., 5700 Roosevelt Rd., Chicago 50, Ill.
Melzer, Howard H., Chief Engineer of Tests, Chicago, Milwaukee, St. Paul and Pacific Railroad Co., 321 W. Everett St., Milwaukee 3, Wis.
Neal, Harold M., Chief Specification Metallurgist, United States Steel Corp., Gary Steel Works, Gary, Ind.
Spanjer, Roy W., Engineer, Mid West Concrete Pipe Co., 228 N. LaSalle St., Chicago 1, Ill. For mail: 1455 W. Fargo Ave., Chicago 26, Ill.
Wahed Ally, Syed Rafiuddin, Student, Engineering Experiment Station, Iowa State College, Ames, Iowa. [J].*

CLEVELAND DISTRICT

Dun, J. G., Republic Steel Corp., Warren, Ohio.
Gunther, M. F., Laboratory Supervisor, United States Stoneware Co., Box 350, Akron 9, Ohio.
Hibbert, Edward N., Chief Metallurgist, United States Steel Corp., 912 Salt Spring Rd., Youngstown 9, Ohio.

Vormelker, P. S., Vice-President and Technical Director, Hershberg Products Co., Box 355, Ashtabula, Ohio. For mail: 4320 State Ave., Ashtabula, Ohio

DETROIT DISTRICT

Electrical Manufacturing Co., James H. Foote, Jr., Vice-President, Engineering, Battle Creek, Mich. For mail: Box 217, Battle Creek, Mich.
Blue, Roy E., Supervisor, Powder Metals Lab., Chrysler Corp., Box 1118, Detroit, Mich.
Coffin, James C., Paint Maintenance Lab., The Dow Chemical Co., Bldg. 298, Midland, Mich.
Killins, David A., Secretary-Treasurer, Killins Gravel Co., Ann Arbor, Mich. For mail: Box 46, Ann Arbor, Mich.
Luckham, Alger W., Architectural Specifications, 23021 Audette Ave., Dearborn, Mich.
Snoddon, William John, Chemist, Minnesota Mining and Manufacturing Co., 411 Piquette, Detroit 2, Mich. For mail: 22901 Gary Lane, St. Clair Shores, Mich.

NEW ENGLAND DISTRICT

Webster Cement Co., W.F., Paul Lennox, Chemical Engineer, 224 Thorndike St., Cambridge, Mass.
Adams, Andrew, Engineer, State Highway Comm., Augusta, Me. For mail: 19 Kennison St., Augusta, Me.
Gerardi, Frank J., Chief Chemist, Narragansett Wire Co., 541 Pawtucket Ave., Pawtucket, R.I.
Ham, John L., Project Manager, National Research Corp., 70 Memorial Dr., Cambridge, Mass.
Holland, S. H., Chief Products Engineer, Whitin Machine Works, Whitinsville, Mass. For mail: 113 East St., Whitinsville, Mass.
Hobbs, Marland C., Secretary-Treasurer, Boston Wool Trade Assn., 263 Summer St., Boston 10, Mass.
Ingle, George W., Research Group Leader, Monsanto Chemical Co., Springfield 2, Mass.
Massachusetts, University of, School of Engineering, Materials Testing Laboratory, Cedric W. Richards, Assistant Professor, Civil Engineering, Amherst, Mass.
Montgomery, G. Milton, Jr., Secretary, The Montgomery Co., Windsor Locks, Conn.
Nott, Charles Allen, Construction Materials

Engineer, Stewart Associates, Inc., 698 Massachusetts Ave., Cambridge 38, Mass.
Patscheider, Walter A., Works Engineer, Walworth Co., First and O Sts., South Boston, Mass.
Waybright, John J., Manager, Everett Refinery, Esso Standard Oil Co., 30 Beacham St., Everett 49, Mass.

NEW YORK DISTRICT

American Mica Insulation Co., John V. Faraci, Vice-President, 410 Frelinghuysen Ave., Newark 5, N.J.
Bridgeport Testing Laboratory, Jacob Dolid, Director, 24 Pulaski St., Bridgeport 8, Conn.
Diamond Head Oil Refining Co., Inc., Martin Morrison, President, 1401 Harrison Turnpike, Kearny, N.J.
Naftone, Inc., C.A. Kelebsattel, Vice-President, 515 Madison Ave., New York 22, N.Y.
Babington, W., Metallurgical Engineer, Bell Telephone Labs., Inc., Murray Hill, N.J.
Belyea, A. R., Chief Chemical Engineer, Consolidated Edison Co. of New York, Inc., 4 Irving Pl., New York 3, N.Y.
Bloomberg, Arthur, Chemical Engineer, Chemical Construction Corp., Box 89, Linden, N. J. For mail: 67 Cedar Lane, Roselle, N. J.
Bryant, Earl R., Technical Service Director, Universal Atlas Cement Co., 100 Park Ave., New York 17, N.Y.
Dexter, Franklin C., Head, Spectrophotometric Lab., Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J.
Emmerson, William L., Manager, Seam Research Labs., Singer Sewing Machine Co., 561 Broadway, New York City, N. Y.
Jernigan, I. C., Assistant Manager, 'Incor' and Technical Service, Lone Star Cement Corp., 100 Park Ave., New York 17, N. Y.
Kaufman, Gus, Assistant Manager, Technical and Research Division, The Texas Co., 135 E. Forty-second St., New York 17, N. Y.
Koosman, Joseph G., Spectroscopist, Allen B Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.
Lorentson, Lawrence A., Technical Engineer, Product Testing, International Business Machine Corp., Inc., South Rd., Poughkeepsie, N. Y. For mail: R.D. #3, Poughkeepsie, N. Y.

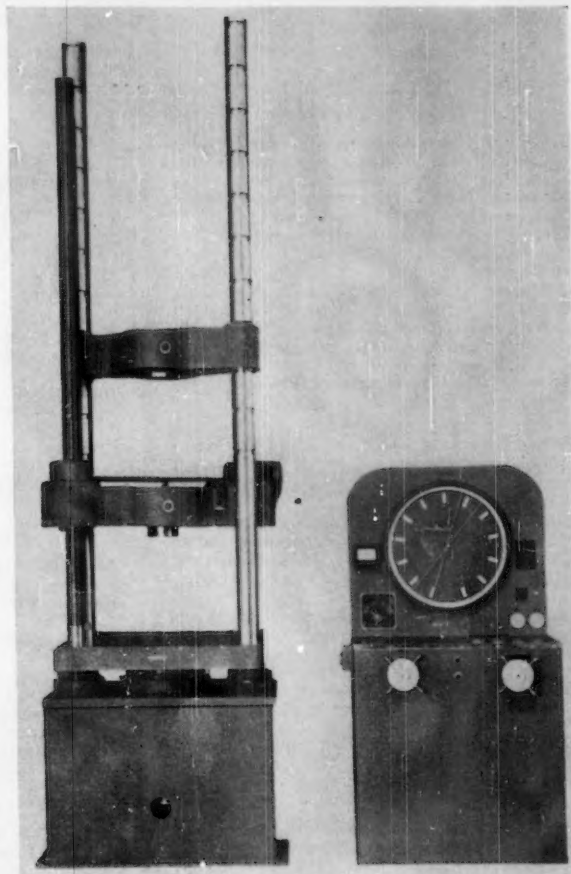
(Continued on p. 70)

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(Continued from p. 68)

Reimers, T. D., Consolidated Edison Co. of New York Inc., 4 Irving Pl., New York 3, N. Y.
Schaus, Richard A., Head, Reactor Development, Knolls Atomic Power Lab., General Electric Co., Schenectady, N. Y.
Skillman, John E., Engineer, Irving Subway Grating Co., Inc., Long Island City, N. Y.
Sternberg, Leon, Production Chemist, Fedders-Quigan Corp., 5801 Grand Ave., Maspeth, L. I., N. Y. For mail: 952 Maple Dr., Franklin Sq., L. I., N. Y.
Tidridge, William A., Research Chemist, Westvaco Chemical Division, Food Machinery and Chemical Corp., 500 Roosevelt Ave., Carteret, N. J.
Tomey, J. G., Chief Engineer, Plastoid Corp., Hamburg, N. J.

NORTHERN CALIFORNIA DISTRICT

Kaiser Gypsum Co., Inc., W. C. Riddell, Director of Research, Box 993, Redwood City, Calif.
Culver, William H., Materials Inspector, Bureau of Tests and Inspections Pacific Gas and Electric Co., 4245 Hollis St., Emeryville 8, Calif. For mail: 351 Marlow Dr., Oakland 5, Calif.
Lindblad, W. N., Chief, Bureau of Tests and Inspection, Pacific Gas and Electric Co., 245 Market St., San Francisco, Calif. For mail: 4245 Hollis St., Emeryville 8, Calif.
San Francisco, City College of, Library, Ocean and Pheland Aves., San Francisco 12, Calif.
Scarlsbrick, Richard G., Draftsman, James & Waters & Associates, 170 Emerson St., Palo Alto, Calif.

OHIO VALLEY DISTRICT

Hamilton Foundry and Machine Co., The, Peter E. Rentschler, President, 1551 Lincoln Ave., Hamilton, Ohio.
Bachman, George S., Director of Research, Pittsburgh Plate Glass Co., Fiber Glass Division, Shelbyville, Ind. For mail: 151 W. Washington St., Shelbyville, Ind.
Clark, Frank X., Metallurgist, Shenango Agaloy Tube Co., Agaloy Tubing Division, 905 Wheel St., Springfield, Ohio.
Ponder, Maurine, Packaging Research, Joseph E. Seagram and Sons, Inc., Louisville 1, Ky.

PHILADELPHIA DISTRICT

Masland and Sons, C. H., C. H. Masland, II, Vice-President, Spring Rd., Carlisle, Pa.
Cook, Albert, Inspection Dept., Lanston Monotype Machine, Twenty-fourth and Locust Sts., Philadelphia 3, Pa.
Fachet, John, Production, Manager, Thwing-Albert Instrument Co., Penn St., and Pulaski Ave., Philadelphia 44, Pa. For mail: 2835 Gilham St., Philadelphia 24, Pa.
Hinkelman, Thomas D., Procurement Standards Engineer, Eckert-Mauchly Division, Remington-Rand, Inc., 2300 W. Allegheny Ave., Philadelphia 29, Pa.
Hoch, Richard C., Chemist, Endura Manufacturing Corp., Fourth St., Quakertown, Pa.
Howard, Alfred B., Chief Gauger, Sun Oil Co., Marcus Hook, Pa. For mail: 1007 Butler St., Chester, Pa.
Kalina, Joseph F., Chemist, Collins & Aikman Corp., Fifty-first and Parkside Ave., Philadelphia 31, Pa.
Stampfle, R. B., Assistant Metallurgical Engineer, Bethlehem Steel Co., Bethlehem, Pa.
Warren, Walter W., Vice-President, The Waylite Co., Box 30, Bethlehem, Pa.

PITTSBURGH DISTRICT

Castle Rubber Co., Harry E. Heiligenthal, General Superintendent, Box 589, Butler, Pa.
Beige, Merle E., Chief Chemist, Esso Standard Oil Co., Thirty-fourth and Smallman Sts., Pittsburgh, Pa. For mail: 6839 Thomas Blvd., Pittsburgh 8, Pa.
Fennick, Harry A., Assistant Superintendent, The Pennzoil Co., Rouseville, Pa.

Hjortsberg, Arthur, Assistant Chief Metallurgical Engineer, United States Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa.
Lazear, M. L., Assistant Chief Research Engineer, Wheeling Steel Corp., Wheeling, W. Va.
Toth, Julius, Material and Standards Engineering Dept., Westinghouse Electric Corp., Beaver, Pa.

ST. LOUIS DISTRICT

Harris, Eugene C., Engineer of Tests, Missouri Pacific Lines, 3001 Chouteau Ave., St. Louis 3, Mo.
Levon, Joseph M., Project Engineer, Ramsey Corp., 3693 Forest Park, St. Louis, Mo. [J]
MacFarlane, Carl C., Structural Engineer, Jones-Hettelsater Construction Co., 1911 Baltimore, Kansas City 8, Mo.
Pierson, Charles U., Jr., Engineer of Tests, Marquette Cement Manufacturing Co., 20 N. Wacker Dr., Chicago, Ill. For mail: Box 1377, Des Moines, Iowa.

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Hesch, Frederick P., Process Engineer, Northrop Aircraft, Inc., Hawthorne, Calif. For mail: 4125 N. Iroquois St., Long Beach 8, Calif. [J]
Pickard, A. L., Braun Corp., 2260 E. Fifteenth St., Los Angeles 21, Calif.
U. S. Naval Civil Engineering, Research and Evaluation Laboratory Library, Construction Battalion Center, Port Hueneme, Calif.

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Fulbright Laboratories, Inc., Lee H. Elizer, Director of Research, Box 1284, Charlotte, N. C.
Standard Lime and Stone Co., The, Kenneth D. Simmons, Chemist, Box 885, Martinsburg, W. Va.
Adams, S. L., Assistant Director of Research, Joseph E. Seagram and Sons, Inc., Seventh Street Rd., Louisville 1, Ky.
Allen, Ralph W., Technical Director, Cochran Foil Co., 1430 S. Thirteenth St., Louisville 10, Ky.
Cuthill, John Robert, Metallurgist, National Bureau of Standards, Enameled Metals Section, 9.4, Washington 25, D. C.
Geil, Glenn W., Metallurgist, National Bureau of Standards, Washington 25, D. C.
Hamill, A. T., Manager, Materials and Standards, Westinghouse Electric Corp., Air Arm Division, Friendship Airport, Baltimore, Md.
Kelley, Melvin A., Senior Test Engineer, Glenn L. Martin Co., Baltimore 3, Md. For mail: 3024 Pinewood Ave., Baltimore 14, Md.

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Brunner, A. H., Jr., Manager, Raw Material, Quality Control, Ansco Division of General Aniline and Film Corp., Binghamton, N. Y.
Fuerst, Eugene C., XeroX Quality Control, Manager, Haloid Co., Haloid St., Rochester, N. Y. For mail: 550 Avis St., Rochester 13, N. Y.
Dale, Edwin L., Chemist, Pierce and Stevens, Inc., 710 Ohio St., Buffalo 3, N. Y. [J]
McKaig, Thomas H., Consulting Engineer, 881 Main St., New York 3, N. Y.
Sharp, T. F., Chief Metallurgist, Morse Chain Co. Division, Borg-Warner, Ithaca, N. Y.

UNITED STATES AND POSSESSIONS

AiResearch Manufacturing Company of Arizona, Gilbert J. Brodie, Metallurgist, 402 S. Thirty-sixth St., Phoenix, Ariz.
Builders Supply Corp., George G. Olson, Research Director, 1400 N. Arco Dr., Phoenix, Ariz.
Dickinson Laboratories, George Dickinson, Co-Owner, 1300 W. Main St., El Paso, Tex.

Sandia Corp., John R. Townsend, Director, Material and Standards Engineering, Sandia Base, Albuquerque, N. Mex. [S]**
Southern Latex Corp., W. J. Mohr, Manufacturing Manager, Box 326, Austell, Ga.
Sperry Farragut Corp., C. F. Colchester, Standards Engineer, Vance Rd. and Weaver Pike, Bristol, Tenn.
Adams, Robert F., Materials Engineer, U. S. Bureau of Reclamation, Denver Federal Center, Denver, Colo. For mail: 530 S. Emerson, Denver 9, Colo.
Brinkman, E. A., Head Engineer, Lockwood & Andrews, Consulting Engineers, 103 N. Liberty, Victoria, Tex.
Hattox, Erwin M., Chief Chemist, Esso Standard Oil Co., Louisiana Division, Baton Rouge, La.
Irvine, Leland K., Engineer and Manager, Intermountain Insulation Co., 333 W. First South, Salt Lake City, Utah. For mail: Box 2398, Salt Lake City 10, Utah.
Smith, William H., Chief Chemist, General Paint Corp., Box 1798, Tulsa, Okla.
Venkatesan, M. N., Research Officer, Central Water and Power Research Station, Government of India, Wanowrie, Poona, India. For mail: U. S. Bureau of Reclamation, Denver, Colo.
Yuill, Calvin H., Director, Fire Technology, Division, Southwest Research Inst., San Antonio 6, Tex.

OTHER THAN U. S. POSSESSIONS

Cobra Industries, Inc., Eugene F. Noel, Vice-President, 500 Dorchester St., Quebec City, P. Q., Canada.
Côme, Pierre, Engineer, Société de Construction des Batignolles, Paris, France. For mail: 66 Avenue Major Cambier, Leopoldville, Belgian Congo.
Bastida F., Rolando, Divisional Engineer, Industria Electrica de Mexico, S.A., Ciudad Electrica, Tlalneapantla, Edo. de Mexico, Mexico.
Czepek, Rudolf, Engineer, The Kanthal Corp., Hallstahammar, Sweden.
Lamme, Nico, Chief Chemist, Netherlands Railways, Hoofdegebouw III, Room 6, Moreelsepark, Utrecht, Netherlands.
Lowenberger, Rinaldo, Metallurgist, "Cornigliano" S.P.A., Casella Postale 885, Genoa, Italy.
Mylonas, Constantine, Consulting Engineer; and Professor, Director, Laboratory for Testing Materials, Athens National Technical University, 42 Patission St., Athens, Greece. For mail: Psylla 6, Athens, Greece.
Núñez, Nohemi Villegas, Industrial Chemist, Guerrero 1211 Nte., Monterrey, N. L., Mexico. [J]
Rhodes, Douglas F., Chief Research Chemist, Canadian Oil Cos., Ltd., 6010 Notre Dame St., East, Montreal, P. Q., Canada.
Richardson, Alan, Director, Stanhope Engineering Co., Ltd., Chapter Rd., London N. W. 2, England.
Schmidt, Raymond, Chief Analyst, Algemene Kunstzijde Unie N.V., Velperweg 76, Arnhem, Netherlands.
Wilson, H. E., Metallurgist, Algoma Steel Corp., Ltd., Sault Ste. Marie, Ont., Canada.

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DEATHS . . .

W. VERNON BRUMBAUGH, of Chevy Chase, Md., and retired Secretary, National Lime Assn., Washington, D. C. (February 14, 1953). Representative of the Lime Assn. in the Society for many years, and active in the deliberations of Committee C-7 on Lime, 1928-1944, serving as Chairman for eight years, and on the advisory, editorial, and other subgroups, including those concerned with nomenclature and definitions; also representing C-7 on main Committee E-8 on Nomenclature and Definitions.

C. H. CARDER, Director, The Cold Rolled Brass and Copper Assn., Birmingham, England (May, 1952). Member since 1937.

LEONARD E. GREINER, Proprietor, Gottlieb Greiner Co., New York City. Member since 1948 and active in Committee D-2 on Petroleum Products and Lubricants.

JAMES WILLIAM MCBAIN, Professor Emeritus of Chemistry, Stanford University, Calif., and internationally recognized authority on soap, died at his home on the Stanford campus, March 12, 1953, in his 71st year. A native of Chatham, New Brunswick, Canada, he received his A.B. and M.A. degrees from the University of Toronto, and his Ph.D. at Heidelberg in 1906. Although world famous for his research in all phases of colloid science, Dr. McBain's most notable achievement was his establishment and direction of the First National Laboratory of India, at Poona. He had joined the Stanford faculty in 1927, and retired from active teaching in 1947. His publications in leading scientific journals of the world number almost 400. A member of ASTM for many years, Dr. McBain's activities in the Society were concentrated in Committee D-12 on Soaps and Other Detergents, where he served on numerous subgroups.

DON L. QUINN, President, Don L. Quinn Container Testing Laboratory, Chicago, Ill. (February 27, 1953). Member since 1937, and active in Committees D-6 on Paper and Paper Products, and D-10 on Shipping Containers, serving and directing in many subgroups.

WILLARD H. ROTHER, retired Metallurgist, Bufflovak Equipment Div., Blaw-Knox Co., Buffalo, N. Y., died December 12, 1952 in Toledo, Ohio, where he had resided since retiring in 1951. A national authority on gray iron, Mr. Rother had joined the company in 1910. A member of the Society

for 27 years, he participated in the activities of Committees A-3 on Cast Iron, and A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys, serving on many subgroups. He also was a member of the Western New York-Ontario District Council for many years.

ERIC SEABLOOM, Crane Co., Chicago, Ill. (February 22, 1953). Representative of his company since 1944 on Joint AWS-ASTM Committee on Filler Metal, Subcommittee IV on High Alloy Steel Filler Metal.

HERMANN VON SCHRENK, Consulting Timber Engineer, St. Louis, Mo. (January 30, 1953). Member since 1903. (See accompanying article.)

DAVID T. WILBER, Research Chemist, Allen B. DuMont Laboratories, Inc., Passaic, N. J. (May 4, 1952). Member since 1949.

Hermann von Schrenk 1873-1953

HERMANN VON SCHRENK, Consulting Timber Engineer, St. Louis, Mo.; ASTM affiliate since 1903, Past-President and Honorary Member of the Society, Honorary Chairman of Committee D-7 on Wood, and Past-Chairman of ASTM St. Louis District Council, died January 30, 1953, in his 80th year, after a long illness.

Born in College Point, Long Island, N. Y., Dr. von Schrenk received his Bachelor of Science degree from Cornell University in 1893; Harvard awarded him his Master of Arts in 1894, and in 1898 he received his Doctor of Philosophy degree from Washington University. For a number of years he was an instructor in plant pathology at Washington University, and was at the same time Pathologist in Charge, Mississippi Valley Laboratory, Bureau of Plant Industry, U. S. Department of Agriculture. For five years he was Chief of the Division of Forest Products, U. S. Bureau of Forestry. During the ten years from 1900 to 1910 he was lecturer on diseases of trees and timbers, wood preservation, and related subjects at Yale, University of Wisconsin, and the Biltmore School of Forestry.

In 1907 he began his career as consulting timber engineer which extended to include work in the railroad engineering field, and until the time of his death he served as consultant for a great number of the country's leading railroad systems, advising them on timber utilization, wood preservation, protection against fire, prevention of marine borer damage, and kindred problems. He furthered many research projects, the

results of which proved invaluable in railroad engineering, and participated in national and international conferences on wood preservation and pathology. At the time of the second World War he was very active in the study and solution of problems concerning the procurement and utilization of timber. He found time in his busy life to do much writing, authoring the books "Decay of Timber and Methods of Preventing It" and "Diseases of Hardwood Trees," and at least 85 published papers.

He was interested in many scientific and technical societies and organizations including the following:

- American Railway Engineering Assn. (Life Member, Director, Chairman of many committees)
- American Wood Preservers (Honorary and Life Member)
- American Bridge & Building Assn.
- American Society of Civil Engineers (Life Member, Chairman Committee on Timber 1928-1950)
- American Society of Naturalists
- American Forestry Assn.
- American Assn. for Advancement of Science (Fellow)
- Academy of Science, St. Louis
- Audubon Society of Missouri (President)
- Botanical Society of America
- Missouri Botanical Garden (Pathologist 1907-1953)
- Missouri Forestry Assn. (President)
- National Research Council, Division of Engineering
- Ornithologists Union
- Deutsche Botanische Gesellschaft

In ASTM Dr. von Schrenk rendered important service in both administrative and technical phases of the work. He was Vice-President 1933-1934, and President 1934-1935; and was elected to Honorary Membership in 1944. One of the organizers of the St. Louis District Council, he served as its Chairman 1939-1946. His contributions in Committee D-7 on Wood are inestimable. A prime mover in the organization of this group, and its first chairman, he directed the activities of the committee for 44 years, 1904-1948, a record of service unsurpassed in the Society. Following relinquishment of active chairmanship, he was elected Honorary Chairman by this group. He also had been a participant through the years in the deliberations of Committee D-1 on Paint, Varnish, Lacquer and Related Products, and of Committee E-5 on Fire Tests of Materials and Construction.

In the passing of Dr. von Schrenk the Society loses a loyal supporter and valued contributor. But those who were privileged to labor closely with him will cherish the intangibles—his stimulating personality, his capacity for friendship, his imagination, his vision, and his great enthusiasm—and the remembrance will inspire continued activity in his chosen field.

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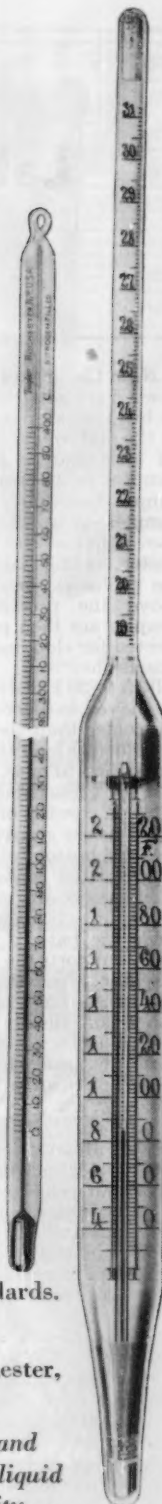
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Fisher Scientific Co., 717 Forbes St., Pittsburgh, Pa.

Static Detector—A new Model 2005 Static Detector announced by Keithley Instruments, clips onto a Keithley Vacuum Tube Electrometer and is said to provide a convenient and highly sensitive combination for detecting and locating static charges. The new Electrometer accessory consists primarily of two concentric, telescoping tubes and a center aluminum rod. When clipped over the HI terminal of the Electrometer, the tubes act as a shield for the rod, limiting sensitivity to a narrow cone along their axis. Qualitative results are obtained by noting the deflection of the meter pointer. Sensitivity can be varied by extending or lowering the inner tube. With the tube lowered to maximum sensitivity, a charged pocket comb throws the pointer off scale from a distance of 10 ft.

Keithley Instruments, 3868 Carnegie Ave., Cleveland 15, Ohio.

Relay Circuit—A new relay circuit of extreme sensitivity was announced recently by the Para Laboratory Supply Co. The completed assembly is said to exhibit very low current requirement for activation, while making available a high current carrying capacity output relay. The circuit is based on a principle of utilization of standard thermionic tubes. A relay is now available it is claimed in which the

required activating current is less than 0.1 microampere, with input resistances of up to 100 megohms. For certain applications, the assembly can be supplied in which activation currents are of the order of 0.01 and as low as 0.001 microampere. The input resistances of the sensing element may be of the order of 500 megohms. All relay assemblies will control circuits requiring as much as 30 amperes noninductive load, through a hermetically sealed snap action relay operating in any position, with a make and break of the order of 25 milliseconds. The relay assemblies lend themselves to accurate control of temperature, position, liquid level, flame, safety, and as safety devices, according to the manufacturer.

Para Laboratory Supply Co., 221 N. Hermitage Ave., Trenton 8, N. J.

Circular Slide rule—A new circular slide rule said to permit rapid determination of safe stacking heights for solid or corrugated fiberboard containers and also to be used in designing containers to meet specified stacking load conditions has been announced by the Forest Products Laboratory. Its name, "The Box Strength Calculator," incorporates the research findings of the Forest Products Laboratory on the relationship between ring crush test of fiberboard components (liners and corrugating medium or plies of solid fiberboard) and the top-to-bottom compression strength of boxes made with the combined board. The Calculator computes stacking strength in terms of type of board, perimeter of box, direction of loading, moisture content of board, and duration of storage.

Quartermaster Food and Container Institute for the Armed Forces, Chicago Quartermaster Depot, U. S. Army, 1819 W. Pershing Rd., Chicago 9, Ill.

Differential Pressure Transmitter—A new instrument designed for differential pressure measurement and transmission has been announced by Taylor Instrument Cos. It is a force-balance transmitter intended to convert differential pressure into an equivalent 3 to 15 psi output. It can be used to measure flow of liquid, steam or gas, liquid level, or specific gravity. The "Transaire" Transmitter has two basic units. The primary is said to sense differential pressure and consists of a two-part, forged steel or stainless steel housing enclosing a Teflon-coated, glass-fabric diaphragm. The inner housing of this unit is shaped to the contour of the diaphragm to permit full overrange protection of 1500 psi to either side of diaphragm; the secondary unit transmits the proportional output air pressure and incorporates a ruggedly constructed, pneumatic force-balance transmitting system. This unit is completely enclosed by a gasketed, cast-aluminum cover, self-purged to keep out corrosive vapors and dust.

Taylor Instrument Cos., 95 Ames St., Rochester 1, N. Y.

Heat Treating Furnace—The Westinghouse Electric Corp. recently announced the availability of a new metallurgical heat treating furnace in which temperatures can be obtained up to 3100 F. A water jacketed chamber, an integral part of the furnace is said to permit work to be cooled as well as heated in a protective atmosphere. The furnace is designed for use of either hydrogen or dissociated ammonia. Four manually operated, counterbalanced doors on the furnace separate its charging, heating, and cooling chambers. Intended for batch type heating, the work is handled on trays and manipulated by push and pull rods. The cooling chamber is constructed of welded steel plates to incorporate a water jacketed housing. Ample cooling surface is provided to assure cooling of the charge below the oxidation point before it is discharged. Heating elements are formed from heavy molybdenum alloy rod into sinuous loops and supported on aluminum refractories. The furnace hearth is made of molybdenum alloy to prevent warpage and provide a smooth, hard surface over which the trays are easily moved. Protective atmosphere consumption for this high temperature furnace is between 150 and 200 cu ft per hour.

Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

New Rosin Core Solder—A new rosin core solder, active yet noncorrosive, has been developed by Federated Metals Div., American Smelting and Refining Co. Known as "RTS 200," in production operations, it is said to have many advantages over ordinary rosin solders. According to the manufacturer, tests show that the spread of Federated's solder is 30 per cent greater than that of conventional rosin core solders. Oxide films and corrosion products on the parts being soldered need not slow down operations, because this solder pierces such retarding agents four times faster than ordinary solders.

Federated Metals Div., American Smelting and Refining Co., New York, N. Y.

Miniature Velocity Pickup—A vibration measuring instrument of unusually small size, the Type 4-118 Velocity Pickup, is announced by Consolidated Engineering Corp. It measures only 1 by 1 in. and weighs only 1.3 oz. The new Type 4-118 Pickup is designed for operation at the elevated temperatures encountered in testing of aircraft turbines, reaction motors, and superchargers and is said to operate continuously at 300 F or as high as 500 F for intermittent periods of up to 100 hr. According to the manufacturer, Type 4-118 is self-generating, sending out electrical signals whose strength varies in proportion to the vibrational velocity of the object on which the pickup is mounted. These signals may be read on meters or oscilloscopes for visual monitoring of vibration, as in inspection and quality control work, or they may be recorded by

(Continued on p. 76)

¹ 1952 Book of ASTM Standards, Part 5, p. 51.

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The ASTM has published all tables applicable to the units of measurement used in the United States, while the IP has published those applicable to units employed in the British Commonwealth. In addition, the IP has published a volume in metric units. Detailed Tables of Contents for the various editions are available from ASTM Headquarters.

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(Continued from p. 74)

multichannel recording oscillographs where permanent records are required. Type-4-118 Pickup may be located in previously inaccessible areas it is said, because of its small size, light weight, and self-generating characteristics.

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

Balancing Motor—A new reversible two-phase balancing motor having a rated speed of 333 rpm (at no-load) has been announced by Minneapolis-Honeywell Regulator Co. The motor was adapted for use in apparatus requiring positive positioning by means of a 60-cycle low-inertia drive motor capable of being operated from an electronic amplifier. When applied to the recorders it is said that the 333-rpm motor provides the necessary torque to drive the pen carriage full scale in about 1.8 sec. Important design features claimed for the new motor include an air vent, self lubrication, and the use of two ball bearings and one needle bearing instead of three sleeve bearings found in other drive motors. The air vent, which is plugged during shipment to prevent leakage, relieves the oil seal from pressure or friction. Self lubrication is accomplished by means of an idler gear. This gear dips into the oil reserve as it rotates in the bottom of the gear housing and transfers the oil to the bearings through the rotor pinion. The two-second motor is designed for use in temperatures ranging from 20 to 175 F. It draws about 13.5 w and operates on a frequency of 115 v, 60 cycles.

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa.

New Model 182 Versa-Scaler—Featuring electrically reset timer and register to speed counting procedures in radioisotope laboratories, a new Model 182 scaling unit has been announced by Nuclear Instrument & Chemical Corp. Now available are two models of this scaler with a variable power supply of 500 to 5000 or 500 to 2500 v, with electrically reset timer and register, or manual reset register with no timer. Slope-mounted in a newly designed cabinet, the unit is designed for precision counting with new simplified controls. An operation switch lights appropriate sections of a plastic panel indicating operation selected. The Model 182 has a Higinbotham scale of 256 with eight-position scale selection switch. High voltage is said to be indicated on panel-mounted 4-in. meter and controlled with Coarse and Fine adjustments with a Stop-Count switch for controlling scaling action, and a Reset switch for clearing interpolation lights and resetting the register and timer to zero. According to the manufacturer, the scaling unit is of particular value in counting applications where low activity radioisotopes are handled. It is claimed that Model 182 permits the use of scintillation and proportional counters, as well as Geiger counters, with its wide sensitivity range and linear amplification from 1 mv to 1 v. The unit operates on standard 110-v, 50-60 cycle power supply.

Nuclear Instrument & Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

Tubing Steel for Elevated Temperature and Pressure Applications—A new technical data bulletin, known as TDC-146 is available, free of charge, from the Babcock

& Wilcox Co. This bulletin discusses B & W Croloy 5 (4-6 Cr, $\frac{1}{2}$ M). This steel is said to be particularly resistant to corrosion from hot oil, hydrogen sulfide, elementary sulfur, and organic sulfur compounds as encountered in petroleum processing. Included in the bulletin are: data on mechanical properties; creep strength; physical properties; welding; fabrication and heat treatment.

Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa.

Westinghouse Electric Corp., Pittsburgh, Pa.—Announcement is made of plans for a new, multimillion dollar plant to produce atomic equipment. The plant will be operated by a newly formed department in the Atomic Power Div.—the Atomic Equipment Dept. The new facility will be located near Pittsburgh. At this plant the company will "engineer, manufacture, and sell products that have been developed for atomic power plants," President Gwilym A. Price reported. The products of the new plant will be special items which could not logically be produced by existing Westinghouse operations, it was explained in Pittsburgh by Charles H. Weaver, manager of the Atomic Power Div. He estimated that the plant initially will employ approximately 200 people. It is hoped that the new plant will be ready for occupancy by late fall of this year. The one-floor manufacturing plant will be of steel construction with the adjoining office area of brick and continuous window sash. The building will provide approximately 87,000 sq ft of floor space.

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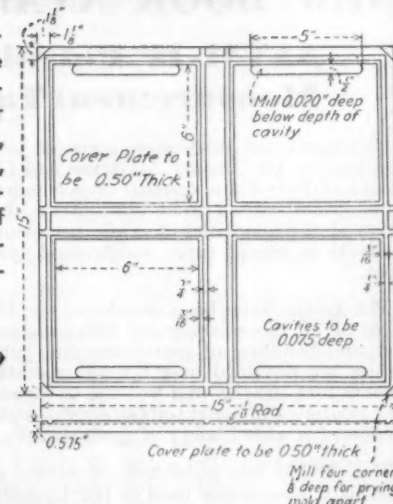
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Catalogs and Literature

Laboratory Thermometer—Recently announced is the publication of "Catalog A-53," a new six-page, three-color folder describing over 300 different laboratory thermometers. These thermometers have a scale range from -200 to $+500$ C. The catalog is available, free of charge, from the Brooklyn Thermometer Co., and includes prices, scale range, and catalog number. According to the supplier, all ASTM thermometers listed are guaranteed to be within accuracy tolerance and dimensional specifications for the ASTM test noted.

Brooklyn Thermometer Co., 217-09 Merrick Blvd., Springfield Gardens, N. Y.

Micromax Instruments—Just announced by Leeds & Northrup Co. is the publication of a revised 40-page catalog outlining the design and construction features of the strip-chart Model S Micromax Recorder. Catalog ND44(1), entitled "Micromax Model S Indicating Recorders and Controllers," contains illustrations of the Micromax and describes: (1) the sequence of galvanometer detection; (2) typical circuits used; (3) standard features found in the basic Micromax instrument; and (4) special features available to broaden the application of Micromax. Details of operation and specifications of standard instruments for measurement and control are listed. The catalog contains a margin-index for added convenience.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Volumetric Analysis—A 40-page manual contains detailed information, instructions, and methods for the Fisher Titrimeter. Included among the eleven chapters are: Potentiometric Titration; Installation; Care and Use of Electrodes; Standardized Solutions; pH Measurement; The Plotting of Titrimetric Curves. The Manual concludes with 15 fully detailed methods, ranging from the "Titrimetric Determination of Chromium in Steel" to that of "Size on Nylon Yarn" and "Dissolved Oxygen in Boiler Feedwater." According to Fisher, a complete method is included for fast titrimetric determinations of water in organic solids and liquids, using the Karl Fischer Reagent.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

General Laboratory Apparatus—The "Eberbach Announcer," No. 53, is now available. Published by Eberbach & Son Co., this issue contains several articles concerning new developments in scientific equipment and laboratory apparatus. Of particular interest is an article entitled "How Temperatures Are Measured." This 19-page magazine lists vacuum pumps, temperature indicators, ultra-speed electro-analyzers, microscope eyepiece camera, manometric microgasometer, hemispherical heating mantles, and many other items for the laboratory.

Eberbach & Son Co., 200 E. Liberty St., Ann Arbor, Mich.

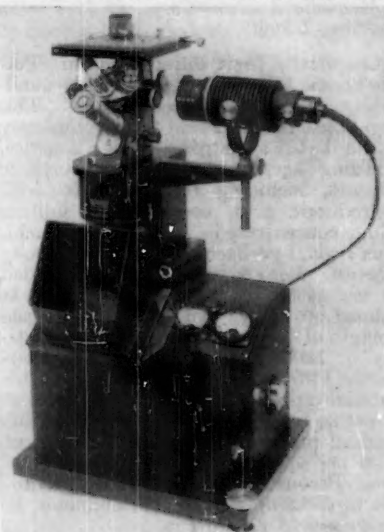
Uses of Persulfates—A 19-page bibliography of the properties and uses of persulfates is now available, free of charge, from the Buffalo Electro-Chemical Co., Inc. In *Bulletin 34*, literature references have been compiled to show the highly diversified uses of persulfates. Among many fields discussed are biological chemistry, cellulose chemistry, for bleaching, polymerization, textiles, organics, and the

(Continued on p. 78)

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United Scientific Co.

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(Continued from p. 77)

rubber industry. Approximately 100 references are cited.

Buffalo Electro-Chemical Co., Inc., Station B, Buffalo 7, N. Y.

Magnetic Comparison Comparators—A four-page bulletin is now available, published by the Magnetic Analysis Corp. Bulletin No. 30 illustrates and describes Production and Single Frequency Comparators for inspecting ferrous materials or parts and the Dual Frequency Comparator for inspecting both ferrous and non-ferrous metals.

Magnetic Analysis Corp., 42-44 Twelfth St., Long Island City 1, N. Y.

Chemically Inert Filter Medium—Porous Plastic Filter Co. announces the availability of pure Porous "Kel-F." This filtration medium is said to be completely resistant to all strong acids, caustics, oxidizing agents, and common organic solvents, including fuming nitric acid, hydrofluoric acid, concentrated sulfuric acid, concentrated hydrochloric acid, aqua regia, hydrogen peroxide, and strong caustics. Porous "Kel-F" recommended for use at temperatures up to 300 F, is claimed to have an ultimate tensile strength of 900 psi and a modulus of elasticity of 1800 psi. According to Porous Plastic Filter Co., the capacities of this material range downward from 500 cfm of air per sq in. of filter surface, at 8 psi differential pressure, and from 110 gpm of water per sq ft at 10 psi differential pressure. Porous "Kel-F" is presently available in disks up to 12 in. in diameter, in thicknesses of $\frac{1}{8}$ and $\frac{1}{4}$ in.

Porous Plastic Filter Co., 30 Sea Cliff Ave., Glen Cove, N. Y.

Laboratory Apparatus—The seventeenth edition of "What's New for the Laboratory" (16 pages), has been announced by the Scientific Glass Apparatus Co., Inc. Among the many items featured are: Two types of low-priced ovens with advantages claimed of hazard-safe heating and extra loading capacity; a six unit extraction rack; a floating thermometer; automatic pipet and vial filling machine; several balances; electrophoresis-convection apparatus; a technique said to be simplified for the extraction and determination of salts of organic bases and acids; a combination serological-utility water bath; improved Beckman Aquameter, various clamps; and various other laboratory aids.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Dial Indicator—Bulletin 98214 (24 pages), recently published by Taylor Instrument Cos., describes and illustrates 6-in. Dial Indicators for temperature, pressure, and load applications. It supplies information on features, dials, and scales available. The Bulletin outlines a variety of sensitive elements or bulbs for temperature instruments and lists mounting dimensions for the different types of instruments.

Taylor Instrument Cos., Rochester 1, N. Y.

—Instrument Company News—

Bausch & Lomb Optical Co., Rochester 2, N. Y.—Carl A. Day, Works Manager, has announced the appointment of John D. Harby as Assistant Superintendent, Eyeglass Frame Div. Harby has been in charge of Factory Engineering, Inspection

and Tool Design, in the Bausch & Lomb Scientific Instrument Div. Day also announced that Charles N. Hendershott, former factory engineer, replaces Harby. Hendershott established Bausch & Lomb's metal plating department, and until recently was in charge of all instrument finishing operations.

Beckman Instruments, South Pasadena, Calif.—Announcement was made of a groundbreaking ceremony for a new two million dollar, 200,000 sq ft instrument factory and administrative offices soon to be erected by Beckman Instruments, Inc. The site of the new factory is the La Habra-Fullerton area in California. The manufacturing area was designed to permit a steady flow through production operations from raw material to completed instruments. A large research and development facility is said to be included in the new plant.

Ford Motor Co., San Jose, Calif.—Purchase of a 160-acre site for a 35 to 50 million dollar assembly plant at San Jose, Calif., was recently announced by Ford Motor Co. L. D. Crusoe, Vice-President, said construction will start immediately. Manufacturing space will occupy 1,000,000 sq ft. Capacity of Ford's west coast headquarters in San Jose will approximate 150,000 cars and trucks yearly for distribution to eleven western states.

Homestrand, Inc., Larchmont, N. Y.—Announcement is made of the appointment of the Empire Tooling Assn., Birmingham, Mich., as exclusive representa-

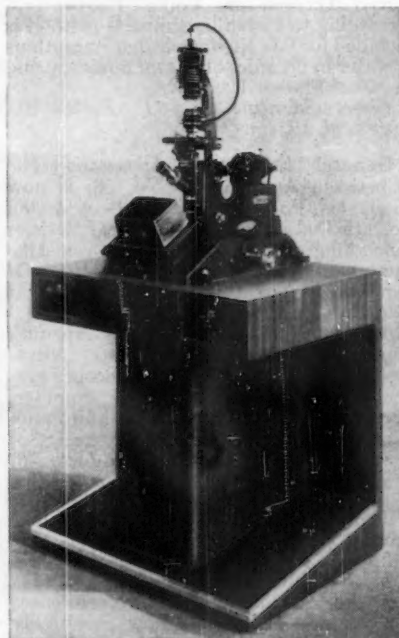
tive for Homestrand, Inc., in the state of Michigan. Located at 148 S. Woodward Ave. in Birmingham, the Empire Tooling Assn. will handle the Homestrand line of "Precisioneered," Swedish measuring tools and instruments, including Metron Height Gauges, Vernier Calipers, and Vipp Dial Indicators.

Nuclear Instrument & Chemical Corp., Chicago, Ill.—James A. Schoke, President, announces that future advertising and sales promotion will identify his company as "Nuclear-Chicago." This step is being taken because of the large number of firms having names similar to the corporate title, which has, in some instances, caused confusion among users of the company's products. Growth since 1945 in manufacture and sale of instruments and accessories for use in measuring radioactivity has made it one of the largest of an estimated eighty concerns in this field.

Radiation Counter Laboratories, Inc., Skokie, Ill.—This manufacturer of radiation detection equipment and nuclear reactor control instrumentation, has announced that Edwin Roy Rathbun, Jr. was formerly with Nuclear Instrument and Chemical Corp. and the Atomic Energy Commission Laboratory at Ames, Iowa. His work has been in connection with research in design and development of radiation detectors and associated electronic systems for special purposes.

Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc., Bridgeport, Conn.—This manufacturer recently

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The "ZC" Galileo is designed to perform research or routine work in metallography, petrography and biology with maximum speed, ease and comfort. Utilizing a vertical optical path, it stands just five feet high, makes seated operation easy and comfortable. In a single compact instrument, it provides everything needed for macro- and micro-photography, polarization, phase, dark field, oblique and standard microscopy in transmitted and reflected light. It will also do multiple beam interferometry. Two independent light sources are provided, and a Zircon arc 100 W bulb with condenser system is available. Switching from transmitted to reflected light is instantaneous, or both may be used together.

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Calendar of Other Society Events

"Long" and "short" calendars will appear in alternate BULLETINS. The "short" calendar notes meetings in the few immediate weeks ahead—the "long" calendar for months ahead.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, INC.—April 20-22, National Open Hearth and Blast Furnace, Coke Oven and Raw Materials Conference, Hotel Statler, Buffalo, N. Y.

METAL POWDER ASSN.—April 20-22, Metal Powder Show and 9th Annual Meeting, Hotel Cleveland, Cleveland, Ohio.

FIBER SOCIETY—April 22-23, Spring Meeting, Roosevelt Hotel, New Orleans, La.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—April 22-24, Southern District No. 4, Louisville, Ky.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS—April 26-29, Chem. Institute Canada, Joint Meeting, Royal-York Hotel, Toronto, Canada.

AMERICAN CERAMIC SOCIETY—April 26-30, Annual Meeting, Statler Hotel, New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—April 28-30, Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio.

NATURAL GASOLINE ASSN. OF AMERICA—April 29-May 1, Annual Convention, Rice Hotel, Houston, Tex.

AMERICAN OIL CHEMISTS SOCIETY—May 4-6, Annual Meeting, Roosevelt Hotel, New Orleans, La.

AMERICAN INSTITUTE OF CHEMISTS—May 12-13, Annual Meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

AMERICAN PETROLEUM INSTITUTE (Division of Refining)—May 11-14, Midyear Meeting, Hotel Commodore, New York, N. Y.

NATIONAL FIRE PROTECTION ASSN.—May 11-15, Edgewater Beach Hotel, Chicago, Ill.

SOCIETY FOR APPLIED SPECTROSCOPY—May 14-15, Annual Meeting, Hotel New Yorker, New York, N. Y.

ASSOCIATION OF IRON & STEEL ENGINEERS—May 18-19, Spring Conference, Hotel Statler, Buffalo, N. Y.

NATIONAL FIRE PROTECTION ASSN.—May 18-22, Annual Meeting, Palmer House, Chicago, Ill.

AMERICAN SOCIETY FOR QUALITY CONTROL—May 27-29, Annual Convention, Convention Hall, Philadelphia, Pa.

SOCIETY OF AUTOMOTIVE ENGINEERS—June 7-12, Summer Meeting, Ambassador & Ritz-Carlton Hotels, Atlantic City, N. Y.

FOREST PRODUCTS RESEARCH SOCIETY—June 15-17, Annual Meeting, Memphis, Tenn.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—June 15-19, Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

AMERICAN WELDING SOCIETY—June 16-17, Spring Meeting, Shamrock Hotel, Houston, Tex.

ASSOCIATION OF AMERICAN RAILROADS—June 22-26 Annual Meeting of the Mechanical Division, Atlantic City, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—June 28-July 2, Semi-annual meeting, Hotel Statler, Los Angeles, Calif.

German Cement

Verein Deutscher Portland-und Hüttenzementwerk e.V. Düsseldorf, Germany, 1952. 165 pp., 58 illustrations and tables.

THE German portland cement industry has been in existence for the past 100 years and in recognition thereof the German Portland and Foundry Cement Society has published a comprehensive text showing the development of the German cement industry from the Middle Ages to the 100-Year Jubilee of portland cement production in 1952.

The volume is divided into three sections: investigations and society activities, production of cement, and construction with cement. These sections explain the development of cement from the earliest mortars to the modern portland-cement concrete, the various steps in cement production, and the most modern uses of portland cement concrete in construction.

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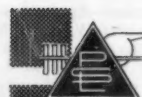
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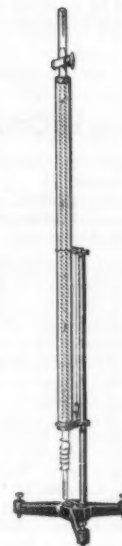
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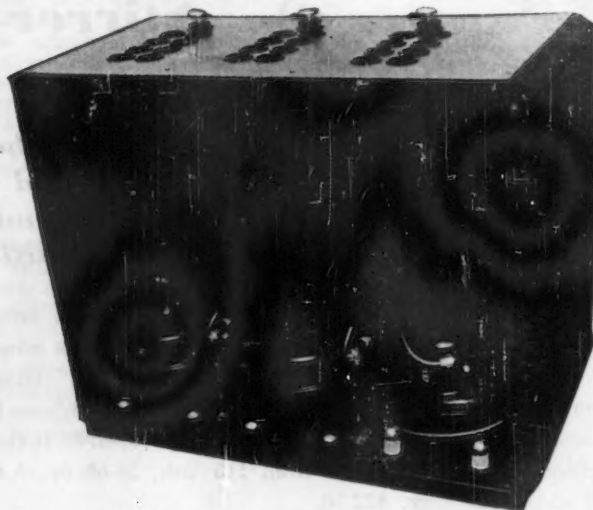
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